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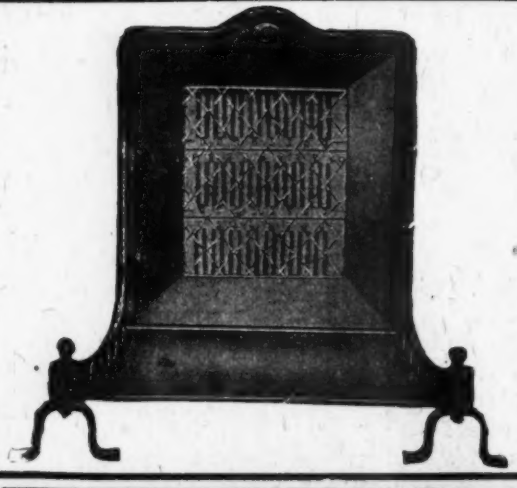

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THE JOINT INDUSTRIAL COUNCILS FOR THE ELECTRICITY SUPPLY INDUSTRY.

THE Whitley scheme is now in full working order in the electricity supply industry. The National Industrial Council was formed in May, 1919, and since then the whole of the country has been mapped out into 13 areas, and a fully constituted District Council is now at work in each area. The whole scheme has, therefore, now passed out of the realm of theory into that of hard fact. In general, up to the present, its development has been on the lines anticipated when the scheme was first inaugurated. But there are almost unlimited potentialities, and the scheme has now been working sufficiently long for certain possible phases of development to become apparent. It may be interesting, therefore, and possibly useful, at this stage to take stock, as it were, of some of these tendencies.

It is necessary as a preliminary to realise that a scheme of Councils of this kind has nothing of the nature of a rigid system. The Councils have nothing, or at most very little, in common with committees appointed for certain fixed purposes, clearly definable, and constituted with clear-cut and limited powers and methods of action. On the contrary, the Councils approximate to an organism. They are not ready-made; they have to grow. Bit by bit they have so to develop as to fulfil the various functions which will successively be demanded of them, very much in the same way as an organism has to adapt itself to its environment.

The duties with which they are charged, and the possible power which will automatically, almost, come to them, open out a wide range of possibilities. For instance, they are charged broadly with the task of dealing with all relations between employés and employers. Initially, of course, this covers settlement of rates of pay and conditions of working. But obviously a consideration of wages involves as a theoretic background the question of profits and the relative claims of labour and invested capital with regard thereto. Conditions of working, too, may cover anything up to the organisation and personnel of the management. Again, Councils in dealing with these matters make recommendations to their constituent undertakings. But a bare recommendation would be futile if it did not also include the use of some influence to back it up so that the recommendations are given effect to by everybody. Accordingly, the Councils must naturally take steps to obtain as much power and influence in every direction as possible so as to insure that their recommendations become effective.

It must be admitted, therefore, that there is an almost immense field of possibilities before these industrial councils; perhaps a much greater one than is generally realised. At present there is in many quarters a tendency to regard them as somewhat of a side-show. But in view of the important position which they may come to occupy in the future, it certainly calls for a most serious consideration from all those who have charge of the industry in order that the Councils may be developed on right and proper lines. It is in view

of this that we suggest it might be well to review briefly the position as it is at present.

First of all we may take it for granted that the Councils are accepted practically throughout the industry both on the part of the undertakings and of the trade unions concerned. The trade unions, indeed, stand to gain considerably. They would perhaps not too readily admit this, and may say that they have now to submit all demands to the strict scrutiny of a Council and that each Council being in ready communication with the others and with the National Council, the chances will be weighted against any but the most strictly justified increases going through. This is correct, of course, but against it there is the immense advantage to them that practically every undertaking in the country is tabulated under a District Council, and consequently facts are quickly ascertainable as to which undertakings are paying the wages agreed upon and which are not. Probably no other industry in the country is in any way so fully organised industrially as the electricity supply industry under these Councils. So far as the undertakings themselves are concerned, the chief advantage for them lies in the fact that now all demands and claims have to be passed to the District Councils, which adjudicate and pass on their recommendations to the undertakings, thus relieving the latter of their former difficult task of considering applications without proper information being available as to whether such claims were being recognised by other undertakings as fair or whether they were being resisted. Also there is now practically throughout the country a complete systematisation of rates of pay and conditions of working down to the minutest details.

Now as regards present powers of the Councils, when they started they placed reliance, as Councils, entirely on the moral force behind their recommendations. Since then, however, their power has been augmented in two very practical directions. In the first place, it has been approved that the Councils can recognise and fully support any steps which the trade unions may take to enforce their recommendations. Any strike called, therefore, consequent upon a refusal may have the full sanction of the District Council, and as the Council is authorised by the Ministry of Labour there is even a quasi-Governmental recognition. The effect of this is to put any defaulting undertaking in a queer position. For instance, it raises the question whether, if an undertaking allowed such *authorised* strike and the supply was stopped, consumers would not have ground of action for breach of contract against the undertaking, since the undertaking had taken a line of action opposed to a properly constituted authority.

In the second place, the Ministry of Transport has given the District Councils an official status under Section 32 of the Electric Lighting (Clauses) Act, 1899, and under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918. The Ministry has ruled that an undertaking when applying for an increase of maximum price shall give notice to the District Council in its area, which can then oppose—the ground of such opposition being that the undertaking is not paying the rates of wages recommended by the District Council, which places a powerful lever in its hands.

The fact that two Government departments, the Ministry of Labour and the Ministry of Transport, both specifically support the Councils and recognise them as formally qualified bodies to act on behalf of the industry, gives the Councils a status greatly superior to that which was usually anticipated. They have thus acquired an added quality of permanency. This permanency is also strengthened by the different structure which the Councils actually took in actual practice as compared with what was laid down. It was originally assumed that the District Councils would follow the structure of the National Council, namely, that the four representative employers' associations should each nominate representatives to act on the employers' side. The construction of the National Council is such, and therefore if the four associations withdrew their members the National Council would fall to pieces. But the District Councils have been formed quite differently. The employers' side has been chosen direct by common voice of the undertakings in the respective areas. District Councils have thus a permanency and are not controlled by any other association.

In effect this constitutes the Industrial Councils virtually self-subsisting bodies already in quasi-independence, even of the individual undertakings in the industry. Add to this the support given by the trade unions and the pressure that could be brought to bear by the union on any small section that tried to secede, and it will be seen that the status of the Councils is *de facto* a very strong one. The tendency of all such organisations is to increase continually in power, and owing to the circumstances we have reviewed above, it is difficult to see how an outside control can be exercised over this. The Councils as an entity have grown more powerful seemingly than the representative associations which created them.

The importance of this will be apparent to anyone who glances over the wide sphere of operations which fall within the purview of the Councils, and which, when the Councils take them in hand in full, will apparently give to the Councils considerable dominancy in the industry. The problem, therefore, before the industry is for the best brains to formulate the economic principles to which these developing powers of the Council should conform. Such conscious directive policy is now needed.

The Electrification of Railways.

THE interim report of the Advisory Committee on this subject to Sir Eric Geddes, of which we give an abstract elsewhere in this issue, is dated July 12th, 1920. Doubtless its terms were at once communicated to the railways which are contemplating electrification; but why should it take over 10 weeks to make the contents public? Although the report is commendably explicit in recommending the adoption of direct current, it defers for further consideration questions relating to the position and general design of the line conductors, and little can be done until these essential matters are settled. The conclusion of the Committee with regard to the standard line voltage is so drastically modified by the exemptions which follow it that it is practically washed out, and we are authorised—subject to the approval of the Minister having been obtained—to use 600, 1,200, 750, 1,500, or 3,000 volts, with either rail or overhead collection, while the locomotives will have to run at two different voltages where necessary. Moreover, the Brighton Co.'s suburban A.C. system is expressly exempted, with a strong indication that the same system will be authorised on the company's main lines to the coast.

Clearly, therefore, uniformity is and will remain a long way off, and the gist of the report is simply that the D.C. system is recommended for all new work, the pressure and mode of supply remaining indefinite. We are very glad the Committee does not propose to disorganise any of the existing systems—unless it be the small experimental section of the Midland Railway at Lancaster; there is plenty of work crying out to be done without our pulling down what we have done already.

The choice of permitted voltages is somewhat incoherent; we would suggest that if the authorised pressures, pending the adoption of a single standard, had been multiples of 600 volts, with 1,800 volts as the standard-elect, so to speak, not only would simplicity have been attained, but also the work of harmonising the existing systems would have been facilitated, for if we are not mistaken, every existing British D.C. railway except the Shildon—Newport section would then have fallen into place in the series. Already the L. & Y. Railway has sections running at 600 and 1,200 volts, and, with the exception above

mentioned, all the rest operate at 600 volts; hence the 750-1,500-volt standard is dragged in by the heels where it is not needed. If the rail conductor is adopted, 1,500 volts is not safer than 1,800; if the overhead system is employed, 3,600 volts is desirable for heavy trains, and will certainly present no great difficulties from a technical point of view. In the United States the great Chicago—St. Paul line has worked for many years at 3,000 volts D.C., and 1,500-volt motors have proved satisfactory; moreover, the heaviest electric locomotives and trains in the world run on this line with an overhead trolley wire, which is much to be preferred to the rail-conductor when a high pressure is employed.

While we do not wish to condemn the report, we think it might have been much stronger and more definite. And now—we want the other one.

Specialism on Labour Questions.

We have never tired of urging that the labour question is one both wide and complex, and that as such it cannot be tackled properly unless proper study is devoted to it. In the electricity supply industry this is pre-eminently the case. It is not too much to say that the future of some sections of the industry is bound up with the proper handling of this matter. And in this determination it is "brains" that will tell. We are, therefore, pleased to see that our view is supported, at least in general intent, by the director of an important group of companies in Mr. W. L. Madgen. At the recent annual meeting of the Provincial Companies' Association, Mr. Madgen said that the time was coming when each large undertaking would have an official whose business it would be to study and deal with labour questions. This clear recognition that time and study are necessary in this matter is gratifying, although we disagree with Mr. Madgen's latest remark, if we rightly read its spirit, as to this relieving the manager of an infinity of "trouble." If this merely means saving him the hack-work of preparing and setting in order the facts of any case, well and good, but if it means that the official is to be the specialist to whom can be relegated all these matters, and who will be instructed to deal with them on some general instruction of not giving away more than he is forced to do, we most strongly disagree with such a tendency as being foreign to the whole spirit of the Whitley report and the dependent Industrial Councils. The Whitley idea, if we may put it somewhat brusquely, was to force the employers (that is, those directly responsible for the undertakings) to meet the representatives of labour *face to face*, and by this means of personal contact, to establish between the two an intimate and reciprocal understanding. As regards the astuteness and wisdom of this aim, there can be no doubt. If, for instance, a director meets the Trade Unions personally week after week, it is impossible but that each will influence the other's views in some degree, and that some measure of common accord will be found, and will in time increase.

But if the "official" system were to grow up, and form as it were, a screen between the Trade Union side and the real "employers," the whole spirit of the Whitley scheme would go by the board as the Councils lapsed into mere quibbling conferences, and however well settlements of wages demands were carried out, employer and employed would be no nearer common understanding.

Australian Criticism.

Members of a young and rapidly-growing community are naturally keenly critical of older institutions. Hence the pungent comment on British trading methods that we have heard from the lips of Australians during the past year or two, particularly from those who, after the armistice, were desirous of returning to the Commonwealth as agents for the sale of United Kingdom goods. At that time, unfortunately, most firms did not feel justified in making such arrangements, and on that account were condemned by our overseas cousins for their lack of enterprise.

More condemnation and criticism of this nature has evidently been poured into the ears of H.M. Trade Commissioner in Australia (Mr. S. W. B. McGregor), who states in his recent report that, although there is a sentiment in favour of British goods, based largely on the fact of their being the best value for the price paid, yet it is well to bear in mind the deep-rooted conviction of many Australians that the British manufacturer is "intensely conservative, unenterprising, generally out of date, and rapidly losing his hold on the world's markets."

These allegations are directed against the manufacturer rather than the merchant, and particularly against manufacturers connected with the machinery (including electrical), motor-car, small tools, hardware and allied trades. The accusation of want of enterprise usually arises, amongst other reasons, from the apparent reluctance of the British manufacturer to increase his output to cope with increasing business, and an alleged indifference to the special requirements of the Australian trade. The view with regard to British manufacturers referred to above may be largely based on ignorance of all the facts, and attributable to some extent to the British habit of self-depreciation and criticism, yet it is worth taking seriously into account unless harm is to be done to British trade.

It is suggested that, *with many notable exceptions*, the fault lies largely with inadequate scientific commercial organisation in the average British manufacturer's business. Subject to the point emphasised in italics (which are ours), we are inclined to agree with this suggestion. Mr. McGregor says:—

"Another matter that appears to be often lost sight of is the failure of some United Kingdom manufacturers to realise their responsibilities with regard to the maintenance generally of British trade prestige overseas and their duty to British trade as a whole."

He refers to the sending-out from home of ill-equipped and unsuitable representatives, and the conduct of correspondence in a careless and slipshod manner, adding that "it is a national duty of every home firm . . . to see that its methods are such as at least not to *lower* British prestige." If Mr. McGregor really has knowledge of circumstances which justify his criticisms, we cannot help thinking that they are exceptional.

Mr. McGregor makes a number of not particularly noteworthy recommendations for developing United Kingdom export trade. Second on his list is one that manufacturers should keep generally in touch with the Department of Overseas Trade, particularly when sending out overseas representatives. Here again, Mr. McGregor's criticism calls for comment. Admittedly, the D.O.T. is doing useful work, but it is of vital importance to its utility and success that it should keep itself more closely in touch with manufacturers generally.

Electric Tramways.

The interesting papers and discussions at the Cardiff Conference of the Municipal Tramways Association, of which we conclude a report in this issue, indicate that the electric tramway industry, after a prolonged period of inactivity, is being spurred on by the strenuous conditions of the times to an anxious consideration of its present position and future prospects. The programme was wisely arranged to cover the commercial, technical, and financial aspects of the subject, and during the proceedings it was made clearly manifest that the conference was practically unanimous in opinion on the following points:—That in order to restore financial stability fares must be materially increased, and every passenger must pay for himself (*i.e.*, "workmen's" fares must be abolished); that working costs must be kept down to the minimum by every proper means available; that the "milch cow" policy, according to which the tramways were compelled to contribute large sums annually to the relief of the rates, was contrary to the public welfare and fatal to the efficient maintenance of the assets; and that in view of the heavy capital cost of new tramways, and the heavy working costs of motor-omnibuses, the prospects for the railless vehicle were distinctly brighter.

"Sound finance" was the keynote of the conference, and we trust that it will be hearkened to by those councillors who have been responsible for bleeding the tramways in the past, as well as by those who, going to the opposite extreme, maintain that funds should be accumulated for the complete renewal of the system without raising new loans. Both policies are contrary to the public interest and to sound principles of administration.

SOME NOTES ON METERING DEVICES USED IN CONNECTION WITH TARIFFS PENALISING LOW POWER FACTOR.

By G. W. STUBBINGS.

The attention that has recently been given to the effect of power factor on the cost of electricity supply, has not only brought into prominence the practicability of modern devices for power-factor correction, but has also emphasised the fact that it is the business of the consumer whose load is of low power factor to bear the expense of installing correcting devices, either directly, or by paying for his energy according to a tariff which increases the average price per unit as the power factor falls. The devising of a tariff that, whilst being equitable, will so far penalise the consumer whose power factor is low as to make it worth his while to install correcting devices, is not a problem with an obvious solution. Probably the best tariff of this kind is one based upon a fixed charge per quarter per K.V.A. of maximum demand, plus a fixed price per unit consumed. Objections have been raised to this tariff, by some, on the ground that it unduly penalises the consumer in that the capital cost of the steam plant depends upon its KW. and not upon its K.V.A. rating; and by others on the ground that the consumer is let off too lightly in that the cost of cables necessary for a given load in KW. increases more rapidly than the K.V.A. It is also a fact that the distribution losses, depending upon the square of the current, vary inversely as the square of the power factor for a given load. All things being considered, however, it is probable that the maximum K.V.A. demand system is as equitable a system as can be devised for large power consumers, and it has the important advantages of being simple, and of taking the load factor into account.

The actual application of any tariff designed to penalise low power factor necessitates the use of some instrument additional to the usual integrating wattmeter for energy registration. For the maximum K.V.A. demand system, the additional instrument must enable this maximum demand to be obtained, either directly, or by the help of the readings of the integrating wattmeter. Two practical methods of obtaining the required information for these special tariffs have been developed, both of which make use of modifications of a standard induction watt-hour meter. One of these methods consists in the use of a meter arranged to integrate K.V.A.-hours direct, the maximum demand being given by an indicator of the Merz type. The second method uses a meter adjusted to integrate the product of the wattless component into the voltage, and such a meter, in conjunction with a standard energy meter, will enable the desired penalising factor to be obtained.

The use of an integrating K.V.A. meter fitted with an indicator, gives readings that are immediately applicable. The ratio of the readings of the energy meter and the K.V.A.-hour meter will, moreover, give a kind of average power factor. This average will not be a true average such as would be obtained from the chart of a recording power-factor meter. The time average of the power factor is $\frac{1}{T}\int_0^T \cos\phi\, dt$, while the ratio of the readings of the energy meter and the K.V.A.-hour meter will be, considering for simplicity a single-phase circuit—

$$\int_0^T I V \cos\phi\, dt \Big/ \int_0^T I V\, dt,$$

a ratio which plainly is not always equal to the time average of the power factor.

The use of a wattless component meter in conjunction with an energy meter would give readings of the maximum power and the maximum wattless component. If these readings be called P and W respectively, the maximum K.V.A. might be taken as $\sqrt{P^2 + W^2}$. For a single-phase circuit this result will be substantially correct, provided the two maxima refer to the same period. Regarding a load of induction motors, it may be assumed, as a rough approximation, that the maximum wattless current will be taken when the maximum number of motors is in use. It, however, does not follow that the maximum power will be taken when this condition prevails. The calculation of the maximum demand in K.V.A. from the readings of the energy and wattless component meters is, therefore, liable to error, owing to possible lack of synchronism of the two maxima. There is, moreover, a further source of error in the case of a three-phase circuit, which will be discussed later. The inherent accuracy of the wattless component meter is, however, higher than that of the K.V.A.-hour meter, and better results will be obtained by the use of the former of these two meters.

The principle of a meter adjusted to integrate K.V.A. may now be considered. For simplicity's sake it is desirable first to deal with the adjustment required, in order that an ordinary single-phase induction meter may register K.V.A. hours, and also to discuss the limits of accuracy obtainable by such adjustment.

If T be the torque of an induction meter, from fundamental principles, $T = k\,I\,V \sin(\alpha - \phi)$, where α is the phase angle between V and the pressure flux.

In the ordinary induction meter $\alpha = 90^\circ$ and $T = k\,I\,V \sin(90^\circ - \phi) = k\,I\,V \cos\phi$. Let ϕ' be an angle given by the relation $\cos\phi' = F$, where F is the average power factor of the circuit in which the K.V.A.-hour meter is to be fixed, and, further, let α be so adjusted as to be equal to $90^\circ + \phi'$.

Then $T = k\,I\,V \sin(90^\circ + \phi' - \phi)$,

and when $\phi' = \phi$, $T = k\,I\,V \sin 90^\circ = k\,I\,V$.

Generally, let ϕ, the actual phase angle, be put equal to $\phi' \pm \theta$.

Then $T = k\,I\,V \sin(90^\circ + \phi' - \phi' \pm \theta)$
$= k\,I\,V \cos\theta$.

Since for small values of θ, both positive and negative, $\cos\theta$ is nearly unity, it follows that, within limits, the torque of such a meter will be proportional to the value of I V, and the meter will register K.V.A.-hours.

If, for instance, the average value of the power factor be taken as 0·85, the angle ϕ' will be 32°.

At power factor 0·7, $\phi = 45^\circ$ about, and $\theta = \phi' - \phi = 13^\circ$.

At power factor 0·95, $\phi = 18^\circ$ about, and $\theta = \phi' - \phi = 13^\circ$.

The torque at each of these power factors will, therefore, be $k\,I\,V \cos 13^\circ$, or $0{\cdot}974\,k\,I\,V$.

Between the limits of 0·7 and 0·95 power factors, the torque of the meter will, therefore, be proportional to the K.V.A., with an overall inaccuracy of 2½ per cent., the maximum torque for a given apparent load in K.V.A. being at power factor 0·85.

Such a single-phase meter would require a phase displacement of about 120° between the pressure flux and the voltage producing it, and as there appears to be no easy method of obtaining such a relationship in a single-phase meter of the induction type, a single-phase K.V.A. meter of this type is only of theoretical interest.

The case of the adjustment of a three-phase induction meter, that it may register K.V.A. hours can now be considered.

It has been proposed to define the power factor of a three-phase current as being the ratio of the actual watts, to the maximum watts obtained by rotation of the voltage vectors. If the power factor, F, be so defined, then the writer has shown in a previous article* that the angle of rotation necessary to obtain the maximum watts is given by the relation $\cos\phi' = F$, provided equality and symmetry of voltages is assumed.

If we may assume that the torque of a three-phase induction meter is given by the relation

$$T = k\,M \sin(\alpha - \phi'),$$

where M is the maximum value of the watts as defined

* Electrical Review, Vol. 84, p. 435.

above, then if an average power factor F_a be taken, giving an angle ϕ'_a such that $\cos \phi'_a = F_a$, and a be so adjusted in each element of the meter as to be equal to $(90^\circ + \phi'_a)$, the torque of the meter will be given by

$$T = k M \sin (90^\circ \pm \theta),$$

where $\theta = \phi'_a - \phi'$, ϕ' being the actual phase angle.

We then finally obtain $T = k M \cos \theta$.

This is a similar equation to that obtained for a single-phase meter, except that the three-phase meter will integrate fictitious K.V.A.-hours as defined by the relation $\frac{\text{watts}}{\cos \phi'}$, instead of actual K.V.A. as given by the usual expression $i_1 v_1 + i_2 v_2 + i_3 v_3$.

An idea of the magnitude of the difference between the actual and the fictitious K.V.A. can be obtained by considering the unbalanced circuit represented by the vector diagram, fig. 1, in which equality and symmetry of voltages are assumed.

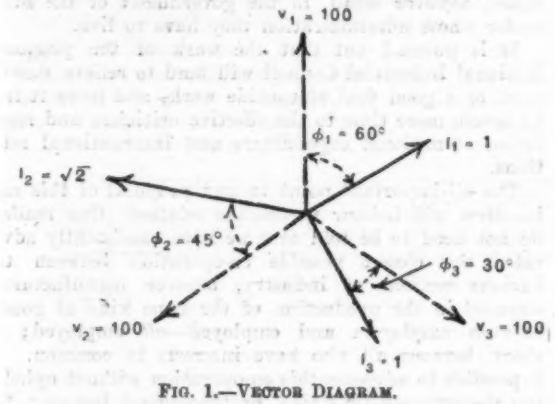


FIG. 1.—VECTOR DIAGRAM.

We have—

$$\text{Watts} = 100 \times 1 \times \cos 60^\circ + 100 \times 1 \times \cos 30^\circ + 100 \times \sqrt{2} \times \cos 45^\circ$$
$$= 50 + 86 + 100 = 236.$$

Volt-amperes $= 100 + 100 + 242 = 342$.

It is easy to show that maximum apparent watts are obtained by rotating the voltage vectors through 45°, when i_2 and v_2 will be in phase.

Then $\cos \phi' = \cos 45^\circ = 0{\cdot}709$.

Fictitious volt-amperes $= M = 236/0{\cdot}709 = 334$.

If the K.V.A.-hour meter connected in this circuit be adjusted to give maximum torque at a power factor of 0·85, this will correspond to a value of $\phi'_a = 32^\circ$. Since the power factor of the circuit in question is 45°, the torque of the meter will be cos (45°—32°) times that at power factor 0·85. Since $\cos 13^\circ = 0{\cdot}975$, the meter will, apart from other errors, read 2½ per cent. slow, and the K.V.A. as given by the speed of the rotor will be 326.

This indication of the meter can be calculated from first principles as follows:—

Assuming that the current coils of the meter are connected in lines 2 and 3,

$$\text{K.V.A.} = i_2 V_{12} \cos (\phi_2 + 30^\circ - \phi'_a) + i_3 V_{13} \cos (\phi_3 - 30^\circ - \phi'_a)$$
$$= 100 \times \sqrt{2} \times \sqrt{3} \cos 43^\circ + 100 \times \sqrt{3} \cos 32^\circ$$
$$= 326,$$

a result confirming that obtained by the previous method.

It therefore appears that a meter constructed on the lines indicated above will give reasonable accuracy as a K.V.A.-hour meter, between power factors of 0·7 and 0·95, provided the circuit is not very unbalanced. With a three-phase meter the necessary adjustment of the angle a can be obtained by exciting the pressure coils from different phases from those used for an integrating wattmeter. This procedure, it need hardly be said, is only legitimate on the assumption of equal phase voltages.

Three-phase integrating K.V.A. meters of the induction type, compensated to record K.V.A.-hours between power factors of 0·75 and unity, are manufactured by Messrs. Landis & Gyr. Such meters would appear to be very difficult to test; and, in view of the fact that an integrating wattmeter would have to be installed in addition to the K.V.A. meter, the use of a wattless component instrument, which is capable of giving the desired information with equal accuracy, whilst being simpler in theory, is probably preferable to the use of an integrating K.V.A. meter of the type discussed above.

(To be concluded.)

LABOUR UNREST.

[The Labour Policy of the National Party.]

It has been cynically observed that we learn from history that no one ever learned anything from history. This much, however, is so obvious as at once to be admitted, that industrial unrest is no new thing. Like the poor, it is always with us. We have previously pointed out that the times before the war were little better, in this respect, than the period of the war itself, and although present evils always appear the worst that have ever been or can ever be, there were railway strikes, coal strikes, building strikes, and other unpleasant events in the world of industry before the war came to throw all our previous ideas of values and wages into the melting-pot.

The great difference between the old days and the present time lies in the fact that more attention is given to the merits of the case. At one time it was common for the man in the train to side immediately with the employers, or masters, as they were then most often called, and to declare roundly that the men were wicked and grasping, deserving nothing better than to be shot down or starved into submission. Such opinions could only arise from a profound ignorance of the whole matter, and the middle classes had not begun to realise the close correspondence between their own case and that of the manual worker.

Nowadays there is an unceasing flow of books, reports, newspaper articles, pamphlets, and publications of every description dealing with the subject of industrial relations. How to secure co-operation between employers and employed, how to improve output to the general advantage, explanations of what is involved in the carrying-on of modern industrial concerns, panaceas of every kind arrive by every post. Our readers will recall many such that have been noticed in the columns of this journal.

On July 9th, 1919, the Grand Council of the National Party appointed a committee to examine the present position of Labour, and make recommendations to the Council for the revision and completion of the labour policy of the National Party. The committee's report was unanimously adopted by the Grand Council on June 9th, 1920, and is now available.

We find in the sixth clause of the report the statement: "Until we establish the basis upon which Capital and Labour can co-operate to their mutual advantage—which is surely the only foundation for industrial peace—we shall omit consideration of that important personnel of industry which constitutes the executive staff, or non-manual workers." Like nearly every scheme that has ever come before us for criticism, this one stultifies itself by deliberately avowing incompleteness at the very outset. The first Whitley Report was defective in this same respect. The most notable exception was the scheme for the Building Trades Parliament, which was well thought out in this as in other ways, and the Priestman scheme for bonus payments depending on the prosperity of the firm during successive four-weekly periods included every employé, whether manual or

non-manual worker. However, though the report is disappointing in this respect, we may hope that the National Party will endeavour to live up to its name, and to serve its own interests by considering the subject on a future occasion.

No harm can, and much good may, have been done by the first-hand investigation of the subject of labour unrest by a committee of thinking men and women, and certain definite proposals have been put forward in this report which are well worthy of examination.

Briefly, it is suggested that, beginning with the staple industries, each industry shall be organised as a separate unit, with a Council of Employers, a Labour Council, and a Joint Council composed of equal numbers of employers and workmen. The Council of Employers shall assume the general direction and administration of the industry concerned, any matter in which Labour is interested being first referred for consideration to the Labour Council for that industry. The Labour Council shall deal with all complaints and suggestions that may arise on the part of Labour, having power to submit for consideration to the Council of Employers questions of administration and other matters bearing on Labour conditions. If any irreconcilable differences of opinion arise, they are to be referred at once to the Joint Council, whose decision shall be subject to reconsideration only by the National Industrial Council. This last-mentioned body is to be formed to represent all the organised industries, and is to be composed of representatives from the Joint Councils, together with not more than four representatives of the Government, who are to act mainly in an advisory capacity, so as to co-ordinate the work of the National Council, while at the same time they shall be deemed to represent the interests of the community. This suggestion is evidently not intended to be funny, but the notion of four civil servants or members of Parliament trying to represent the poor consumer during the intervals of lining-up the relations between all the industries in the country, is one of the most humorous ideas that has ever penetrated through the dull murk which has for so long surrounded industrial problems as the smoke surrounds the factories which house these problems. "The Four Just Men" would either have to run the whole show, or be reduced to the position of absolute nonentities.

The suggestion that the administration of unemployment insurance in each industry shall be handed over to the Joint Council of that industry is a good one, and we hope and believe that the time is rapidly approaching when each industry will have to carry its own unemployment as a definite charge against its administration, to be reduced, like other administrative charges, by successful management.

Criticism is expected, and some criticisms are met. The view has been urged that there would be a tendency for each trade or industry to form itself into a trust, and to exploit the consumer. The report suggests that the National Industrial Council would afford a safeguard in this connection. We do not believe that there would be any greater tendency towards the restriction of competition than there is to-day, and certainly propositions of that sort would most emphatically *not* come before any of the proposed Councils, but would be dealt with in quite another manner.

The next criticism that is anticipated is, that Whitley Councils already exist in some 60 trades. This criticism is answered by the statement that Whitley Councils have not yet been established in any of the large staple industries, such as coal or engineering. This is true, and it is at least unlikely that the opposition which Labour has evinced towards Whitley Councils will be lessened when another kind of Council is proposed, having much the same functions. A stronger answer is that Whitley Councils appear to be limited in their operation to the consideration of difficulties after they have arisen, whereas the proposals of the report have in view the removal of causes of difference before they become acute. There seems to be a tendency here, as there seemed to be in the Building Trades Parliament, towards Guild Socialism. We do not say this in any disparaging sense, and it is perhaps no bad thing that each trade should be to a large extent self-supporting and self-administered, provided that over all sectional governing bodies the authority of the general body of the people as expressed by Parliament remains paramount. Many hard things have from time to time been said about parliamentary government, and some of them have been but too well-deserved. The fact remains, however, that it is wrong that any one class should govern the whole community, whether that class be the feudal barons, the great land-owners, the priesthood, or the proletariat, and up to the present the ballot-box has provided the only means whereby all can have some share, however small, in the government of the State under whose administration they have to live.

It is pointed out that the work of the proposed National Industrial Council will tend to relieve Parliament of a good deal of routine work, and leave it free to devote more time to the effective criticism and regulation of national expenditure and international relations.

The all-important point in any proposal of this sort is: How will Labour regard the scheme? Our readers do not need to be told that we have consistently advocated the closest possible co-operation between the various sections of industry, between manufacturers engaged in the production of the same kind of goods, between employers and employed—*all* employed; in short, between all who have interests in common. It is possible to advocate this co-operation without upholding the sympathetic strike, or the general lock-out, for we believe it to be wrong to injure those against whom there is no grievance, or to hold up the community, in order to bring one obdurate employer or set of workpeople to reason. We believe it cannot be denied with either truth or conviction that the attitude both of employers and of the general public is much more tolerant than it has ever been, and employers will be found to advocate co-operation throughout most industries. Labour, at present, is inclined to be intolerant, and we see in this intolerance the evil fruit of the wicked system of cutting piece rates and attempting to limit earnings, against which we have so often protested. It is scarcely to be expected that Labour will immediately believe the promises of employers that they will never do so any more, though we feel that in this matter many have acknowledged their transgression, and their sin is ever before them.

There is much that is good in these propositions, and there is no reason why Labour should not accept them, or something like them. It will take time, and it will take patience, and we hope the authors are prepared to give both.

A New Electroscope.—Demonstrations took place at the Polytechnic Academy at Copenhagen recently on the occasion of the centenary of Hans Christian Oersted, the Danish philosopher and original worker in electro-magnetism, of two inventions by two Danish engineers, Messrs. Rahbek and Johnsen. The daily Press reports that by sending an electric current through certain substances such, for instance, as lithographic stone (a slaty limestone), an adherent force in some respects resembling, but entirely different from electro-magnetism, is produced. The two inventors have constructed a small electroscope which far exceeds, it is said, all other types in sensitiveness and ease of handling. The discovery of the new physical phenomenon will inspire, it is thought, a series of inventions both within and without wireless technique. The first will be greater speed in wireless reception, apparatus constructed on the new principle being capable, it is said, of increasing a station's capacity to receive or dispatch 20 times. The inventors are reported to have picked up messages from different European stations, and by specially-constructed apparatus were able to take down the words at the rate of 600 per minute. For a second experiment, one of the inventors went to a house which was connected with the demonstration room by wire and played on a violin. This was distinctly heard by the gathering in the demonstration room. The inventor then talked into his violin and another violin in the audience's room repeated his words; in fact the violin became a loud-speaking telephone.

COAL RECORDS.

By A. CLEGG, A.C.I.S.

In view of the difficulties being experienced at the present time by the majority of electricity undertakings in maintaining stocks of coal or even being able to keep running, it may be of interest to your readers to know the methods adopted by a large undertaking to keep the engineer and all concerned with the coal question in touch with the position at any moment.

For some time past it has not been possible to make contracts, but the position is a little easier now, and the rulings of the coal contract book, fig. 1, provide for the details of the contract, or deliveries if a contract has not been made.

The rulings are practically self-explanatory, but may seem elaborate to many; for instance, the columns "pit price," "railway rate," "wagon hire," &c., were introduced when the Coal (Pit's Mouth) Order came into force, so that these rates could be easily checked, but they are also useful where coal can be water borne, as they give an indication as to which is the cheapest route from the pit.

Agmt. No.	Name of Colly.	Period.	CONTRACT. Date of Commencement.	Date of Expiry.	Total Quantity.	Rate of Delivery.	PRICE PER TON. At Pit.	Railway Rate.	Wagon Hire.	Deliveries.	Size & Class.	Date.	Invoice No.	T.	c.	q.	£	s.	d.

Fig. 1.—Coal Contract Book.

Name of Colliery	Truck No.	Date arrived.	Date discharged.	Re weight. T.	c.	q.	Tare. T.	c.	q.	Net Weight: T.	c.	q.	Colliery Weight. T.	c.	q.	Difference. T.	C.	q	+ or − T.	c.	q.	Delivery Bunkers.	Delivery Stacks.	Remarks.

Fig. 2.—Coal Weigh-book.

Let us assume a contract has been made, the document filed, and the coal contract book entered up; a memorandum is sent to the weigh office stating the total amount of the contract and the weekly or daily amount agreed to be delivered.

Daily advices from the collieries are sent to the weigh office, and as the trucks are received into the siding and pass over the weigh-bridge, details are entered into the weigh book, fig. 2. This book is in duplicate, and a daily sheet is made out and sent to the accounts department, which takes up with the collieries any shortages, makes out a weekly list of deliveries from each colliery for the station superintendent, and also enters up the contract book for checking against the invoice.

In the undertaking where these forms are used, a great deal of coal is received from local collieries by motor traction, carting, and by boat, and the same weigh-book is used to keep a record of all coals received in this manner, there being a separate weigh-office at the entrance to the works where all carts are weighed, and the respective weights put into the weigh-book. The coal received by boat is unloaded at the wharf by a crane which tips into railway wagons, and is hauled by locomotive to the weigh-bridge and conveyor in the same manner as that coming by rail.

Date of Sample	Date of Test.	Proximate Analysis % F.	C.	V.	A.	M.	Size % Thro. ½" mesh.	¼" mesh.	Nature of Coke.	B.T.U. $\frac{V}{V+C} \times 100$	Evap. Power.	Nett Available Comb.

Fig. 3.—Coal Test Form.

In the tariff of this undertaking there is a coal clause which provides for variation in the charges in accordance with any increase or decrease in the cost of coal. This, of course, necessitates records being kept of the cost of handling coal by the steam crane, motor wagons, carts, &c., but I do not propose to show the forms adopted for these records.

It will be seen that the daily weigh-sheet also records whether the coal is put into bunkers or on stacks, and so an accurate record of stock can be kept. A weekly list is also kept of all coal put on to the stack or taken off, and a copy of this is sent to the station superintendent.

The Board of Trade, up to quite recently, has required particulars of stocks of coal each week and for the corresponding period last year to be furnished. The above method was found most useful in this respect, and at the present time the same information is sent to the District Coal Committee.

From time to time samples of coal are taken from the trucks and tested, and a form is filled up giving the information detailed in fig. 3. After the engineer has seen and initialled this form it is filed with the contract.

The foregoing books and form give all the information required, as at any time can be seen the total amount of coal contracted for but not yet delivered, how each contract and prices stand, and particulars of each day's advices and deliveries can be got from the weigh-book. Stocks of coal can be readily ascertained from the records sent to the accounts department, shortages in wagons are dealt with at once, and records are kept of the calorific values of the different kinds of coal.

NOTES FROM CANADA.

(FROM OUR SPECIAL CORRESPONDENT.)

In the *Electrical News*, published in Toronto, for August 15th, some interesting figures on the winter production of eggs are quoted from a United States poultry journal.

The following figures are given as results obtained by using electric lighting for an hour in the morning and until 6.30 in the evening, on 400 breeders which were giving only about 15 eggs per day at the time the lighting was tried:—

December	10	...	15 eggs	December	21	...	29 eggs.
"	11	...	8 "	"	22	...	81 "
"	12	...	15 "	"	23	...	127 "
"	13	...	13 "	"	24	...	139 "
"	14	...	12 "	"	25	...	143 "
"	15	...	15 "	"	26	...	195 "
"	16	...	17 "	"	27	...	215 "
"	17	...	17 "	"	28	...	208 "
"	18	...	15 "	"	29	...	217 "
"	19	...	30 "	"	30	...	221 "
"	20	...	35 "	"	31	...	230 "

While the writer of these notes is in no position to criticise these figures, if those of the latter half of December be really due to the use of artificial light, there is surely something to be said for electric lighting, and that during a period when eggs are normally scarce.

The subject of the electrification of steam railways on this continent takes on a somewhat different aspect from what it does in England on account of the enormous water powers available in many parts.

It has been estimated recently that the electrification of all the railways in the United States, even if steam generating

stations were employed to supply the power, would effect a saving of about 70 per cent. of the coal now used, the actual saving being about 122,500,000 tons. If, as could undoubtedly be done in many cases, hydro-electric power were used wherever possible, there would be a further saving for every H.P. generated by hydraulic power of at least 3.0 lb. per H.P. Similar proportionate results would be obtained in Canada, and in the Provinces of Quebec and Ontario, which possess no coal but abundant water powers, the benefits of electrification would be almost incalculable were it found commercially feasible to carry it out on a large scale.

It may not be generally known that both Nova Scotia and New Brunswick now have Hydro-electric Power Commissions which are investigating the water powers of their respective provinces. It has been recently stated that the water powers of Nova Scotia capable of commercial development aggregate some 300,000 H.P., an amount not to be despised even though, unlike Ontario and Quebec, Nova Scotia possesses plenty of coal. Both of these Commissions are believed to be embarking on a policy of actually developing several water powers.

In Toronto the franchise of the Toronto Street Railway Co. expires next year, and a special Transportation Commission has recently been formed to go into all matters affecting the tramways for the city, so that the lines may be taken over from the company when the franchise terminates; as Toronto now has a population of over half a million people, and covers a large area, the problems connected with this matter are neither small nor unimportant.

In the Province of Alberta there has recently been passed an Engineering Profession Act, for the purposes of which professional engineering is divided as follows: Civil, electrical, mechanical, and mining, but provision is made for the formation of new branches. Under this Act the Association of Professional Engineers of Alberta is the officially recognised body representing the profession. Legal status for engineers is being sought in other parts of the Dominion.

The Bell Telephone Co. of Canada has recently created a great stir in Ontario by announcing its intention of making an extra charge on all business telephones numbering more than four calls per day; most of the towns and cities and many associations of business men have agreed to fight the company on this point with a view to having the proposal quashed.

There is once more a coal shortage in Ontario, particularly so with regard to bituminous coal, deliveries of which from the United States are up to date only about 70 per cent. of those of the past few years up to the same date. It must be explained here that the bituminous coal is used almost exclusively for power purposes, while, for heating, anthracite is mostly used, and the fact that there is a shortage of bituminous coal is aggravated by the further fact that there is also a shortage of hydro-electric power which will not be relieved until the Queenston-Chippawa power development of the Hydro-electric Power Commission of Ontario is ready to supply power, which will not be until September next year.

The *Canadian Engineer* states that serious consideration is being given in Northern Ontario to the possibility of basing upon its wealth of water power a great industry to rank with mining, farming, and pulp-timber production, viz., that of nitrogen fixation.

It is not known to the writer whether any particular method of fixing nitrogen is being considered, but it is not likely that the arc process will be of much use on account of the usually high cost of developing Canadian water powers, which greatly exceeds that of some of the Norwegian water powers.

Some months ago, following upon the serious conditions which arose last winter in South-western Ontario, due to the shortage of electric power on the Niagara system of the Hydro-electric Power Commission, this Commission announced that it would build a steam plant, as an auxiliary, having an initial capacity of 50,000 H.P., which would be capable of extension to double that figure. It has recently been announced, however, that the cost even of a 50,000-H.P. plant would be about 5½ million dollars, and that, consequently, the plant is too expensive to build; further, such a plant could not be constructed before December of next year, and it is expected that power will be available, as stated above, from the Commission's Queenston-Chippawa development before that date.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Double-acting Solenoid.

A solenoid which is double-acting and at the same time will attain a neutral position has been developed to operate a duplex friction clutch at the works of the United Zinc Smelting Corporation, Moundsville, W. Va., U.S.A. According to the *Electrical World*, the device pulls equally well in either direction with a nearly uniform pull throughout its travel, and a very long travel may easily be obtained. Moreover, in moving to its neutral position it develops a pull equal to the forward or reverse pull, and does not appreciably overtravel the neutral position. The solenoid consists principally of a field coil inside of which moves a hollow plunger, around which is a specially divided winding. This plunger has grooves upon its surface in which the coils are wound.

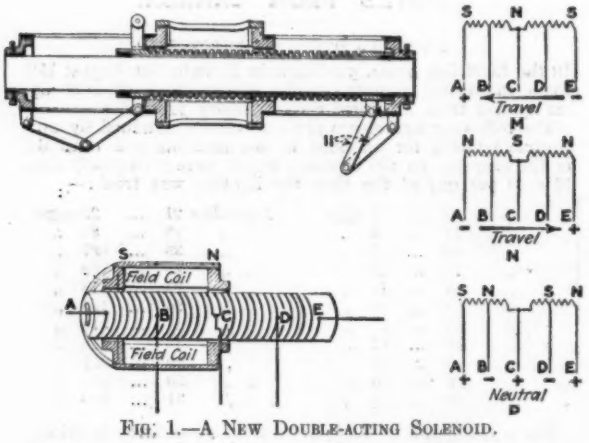


FIG. 1.—A NEW DOUBLE-ACTING SOLENOID.

From the centre to the right end the winding is left-handed, and from the centre to the left end the winding is right-handed. The length of the winding in the grooves is twice the length of the field coil. The operation of the solenoid is as follows: The field coil is entirely surrounded by an iron enclosing cylinder and the end pieces of the cylinder are also of iron. Therefore, when this coil is excited a magnetic flux is set up through the cylinder end pieces, and the sliding armature. The hollow armature slides upon a guide of iron which increases the flux. Referring to fig. 1, when the current is sent from A through to E, the armature will tend to move to the left until the right-hand end of the armature is underneath the end of the field coil, because the current in the left end of the armature runs in one direction, while that in the right end runs in the other direction, owing to the reversal of the winding at the point C. This causes a north pole at the left end of the armature and a south pole at the right end. These poles tend to get under opposite poles of the field coil, and hence move the armature in a left-hand direction. To reverse the direction the current is reversed in the armature. In order to make the armature assume its neutral position current is massed as indicated in P. This makes a north pole at B and a south pole at C, which move the centre of the armature directly to the centre of the field coil. Connection with the different parts of the coil is made by means of flexible wire fastened to the links (11) as shown in fig. 1. The principle of the action of the machine, for which patents have been asked, corresponds to that of a D.C. motor, therefore the travel is slow compared with the solid plunger solenoid. This is due to the counter-E.M.F., generated by the moving plunger, which reduces the current and the pull as the speed increases. By making the housing long enough the plunger will overtravel, and a counter-force produced by the reverse winding coming under the field coil will stop the plunger before it strikes the end framing. On a test of a solenoid of this type with a 3-in. (7.5-cm.) plunger, ¾ in. (2.25 cm.) thick, and 15 in. (37.5 cm.) long with a consumption of 500 to 600 watts, a pull of 40 lb. (18 kg.) was developed with a 6-in. (15-cm.) stroke.

Porcelain-insulated Heating Elements.

With further reference to our recent notes on the above subject, we are informed by MESSRS. BELLING & Co., of Montague Road, Upper Edmonton, N. 18, that they have for some 12 months past been experimenting with a type of heating element that consists of a number of porcelain bridges in place of the usual eyeleted mica bridge. The firm has sent us a photograph, which, however, is unsuitable for reproduction, of an early element that was first put on test about this time last year. It consists of a number of bridges which are threaded through large holes on one side of a channel, projecting lugs passing through smaller holes on the other side of the channel. The bridges are then held in position by means of wires passed through holes in the projecting lugs. In addition to bridges having holes in them, the firm has also tried others with slotted holes, and, in fact, is still improving on its particular type of element.

New A.C. Motors.

Messrs. Higgs Bros., of Sand Pits, Birmingham, have recently placed on the market a line of induction motors fitted with both squirrel-cage and wound rotors. An illustration of the wound rotor machine is shown in fig. 2.

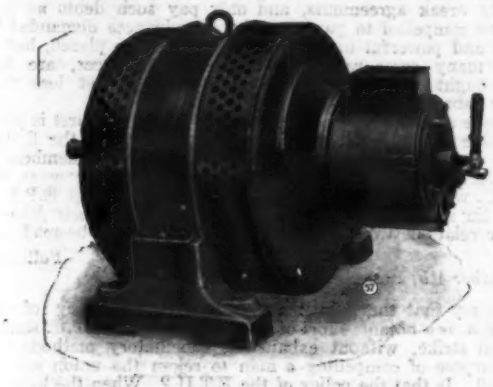


Fig. 2.—Higgs Bros. a.c. Motor.

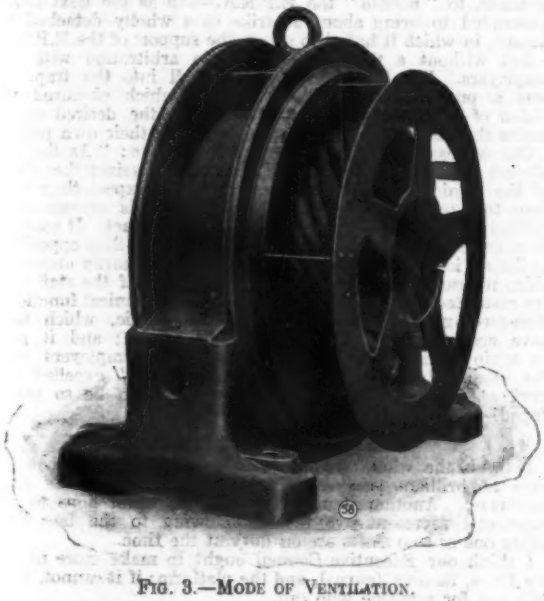


Fig. 3.—Mode of Ventilation.

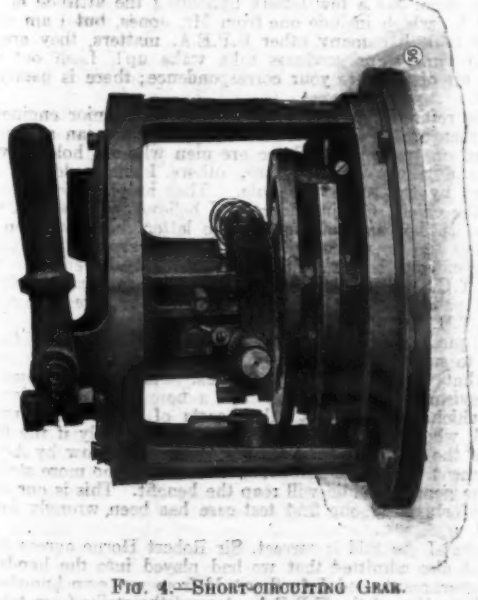


Fig. 4.—Short-circuiting Gear.

The terminals are fitted in the feet on a specially insulated terminal bar, on the same principle as in their standard direct-current motors.

The method of ventilating the machine is illustrated in fig. 3; the centrifugal fan is larger in diameter than the stator coils, and draws the air through the perforated openings on one side of the machine and through the stator coils, rotor coils, and rotor core, and exhausts on the other side of the machine. The motors are fitted with ball bearings, and built throughout to the British Standard Specification for Electrical Machinery. The range that is now being manufactured is from ¼ h.p. to 70 h.p. Each machine is provided with a box containing spares that may be required for the motor, including bearing grease, spare brushes, lubricators, running instructions, &c.

The slip ring gear as illustrated in fig. 4 is of the short-circuiting and brush-lifting pattern. Two rings are fitted on a vertical hub which revolves with the shaft, the third phase being earthed. The short-circuiting switch acts through the centre of the shaft end on extension of the slip rings. The brush moving parallel with the switch, considerably simplifies the construction of this gear. Both operations are performed by moving a lever about 120 degrees. The operation is very definite in action. A tapped hole suitable for conduit is provided in the slip-ring cover for the cables. The squirrel-cage rotor was illustrated in a recent issue.

Pendant Lantern.

Mr. B. N. Dolan, of 8, Bedford Street, Halifax, has devised a lantern to be fixed on any lamp holder like a shade, which is suitable for porches, warehouses, &c.; it consists of a 12-inch black and white enamel reflector and a clear glass globe.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Ex-Service Men First.

On the day before I left England for this country I saw advertised in your issue of June 11th, "Wanted municipal electrical engineer, George Town, Penang. Apply Preece, Cardew & Rider, &c." I applied, and sailed on June 13th.

In the *Penang Gazette*, August 11th, is a report of the Municipal Commissioners' meeting, where it was stated by the chairman that they had been advised by their English agents that no suitable man had applied to them.

I applied for about 16 municipal posts before I left the old country, but in every case a non-service man was appointed. The pity of it is that out here they have a curious preference for the man who served, and I put in four years' active service.

I do trust that the King's appeal to the home municipalities will bear good results, and I do plead with consulting engineers and others to give the ex-Service man even preference. The Colonies like them.

H. M. Taylor.

Taiping, F.M.S.
September 4th, 1920.

Electric Welding.

In reply to Mr. Bevan Smith, fragments selected from any article often appear to be contradictory when detached from the context.

The values given in the article on electric welding are practical results obtained after two years, and are quoted as a useful guide for general welding work. To obtain the best and quickest results the voltage figure should not be absolutely inflexible, and a little latitude to the welder in this respect is recommended. It is just the difference between theory and practice.

The generator voltage range of 30 to 100 is quoted so as to include the practicability of railway or tramway work, within the scope of a portable welding set. Such a unit was referred to in order to show the limits required to cover the voltage range for all welding work.

Regarding metallic electrodes, welding with 20 volts means a very short arc, accompanied by a frequent welding-up of the electrode to the job in hand, and was thus discontinued, and the voltage figure raised to 25, using a slightly longer arc. This has proved eminently satisfactory from the writer's point of view. The figure of 5 kw. per welder is obtained after taking the mean of watt-meter readings, on various welding plants, and cannot be deduced by a simple calculation.

A useful guide to the size of plant required is to allow for two out of three welders to be operated at any instant (owing to frequent interruptions in the circuit).

Electrode.

September 27th, 1920.

Mr. H. Bevan Swift, in his letter in your issue of the 24th ult., criticising the article on electric welding which appeared in your issue of the previous week, lays himself open to criticism in his condemnation of the self-excited reverse-compound-wound generator.

In his statement that without separate excitation the reverse-compound-wound machine would be a failure, Mr. Swift is

either attempting to mislead your readers or he must be somewhat behind the times in the matter of this type of generator; perhaps it may be of interest to him to know that self-excited and self-regulating reverse-compound-wound generators are on the market, and have proved entirely satisfactory, and not the "failure" he makes out this type of generator to be.

Without entering into a technical discussion of design, I would like to say that the particular machine I have in mind is so designed as to give a no-load or striking voltage of 60 volts which, when the arc is struck, automatically decreases to the voltage required by the arc, which for average good work and the average operator is from 18 to 20 volts for bare metallic electrodes.

The current output is controlled by a dial switch which puts into circuit varying amounts of series winding.

As stated above, this set is self-excited and self-regulating, and the mechanical and electrical construction is simple and in accordance with modern standard practice.

The rating of the single-operator set is 60/20 volts, 200 amps., 4 KW.

J. W. Beswick.

Rugby, *October 4th*, 1920.

Proposed Sea Tunnels.

In your issue of the 24th ult., page 405, *re* the above, you quote the *Railway Gazette* as saying: "Passengers leaving Paris by the proposed route could reach Dakar (Senegal) in three days without changing trains."

I personally thought so, and wrote to the Press some time previously, to the effect that I considered the whole of the Eastern Hemisphere, where actually possible, ought to be joined up by railways.

I have since heard (whether correct or not I do not know) that the Spanish railways employ an *entirely different gauge* to the French railways, thereby necessitating great expense, for through transit.

D. R. Broadbent.

October 2nd, 1920.

Domestic Supply Pressure and Wiring.

Following up the remarks by Mr. B. W. Gothard upon C.T.S. cable for house wiring, some contractors point out the disadvantage of C.T.S. buried in plaster, due to its liability to be punctured by nails and the inability to withdraw faulty cable, or to carry out alterations. The method that I have devised is as follows: I run short lengths of C.J. conduit from switch points to floor joists, also from switch points to false ceilings when buried in plaster. Wiring with C.T.S. is simplicity itself, by making a ring main with twin 3/.029 to lamp points, and short lengths of twin C.T.S. from lamp points to switch. The necessary connections are made with small porcelain connectors underneath the ceiling rose pattress of the ordinary type. For 3-light fittings a length of 3-core C.T.S. is used from lamp point to switches. Also 3-core is used for staircase lighting between both switch points with the necessary 2-way switches.

E. Ellis.

Chester, *October 4th*, 1920.

The E.P.E.A. and the E.T.U.

Judging by the amount of correspondence you have published in the last three or four issues of the ELECTRICAL REVIEW relating to the E.P.E.A. and its attitude towards the present—or recent—trouble in the electrical industry, one is led to believe that considerable interest has been aroused amongst certain sections of electrical engineers, but unfortunately the writers appear in almost all cases to have missed the point of the action at which they are so much distressed.

They all accuse the Executive of the E.P.E.A. of "siding" with the E.T.U., and as such is not strictly accurate, it seems to me very necessary for someone to draw attention to this fact.

The E.P.E.A. has not sided with the E.T.U.; instead, the E.T.U. has adopted the principle of the E.P.E.A. The E.P.E.A. has followed the path that every right-minded person or body must follow if lasting success is to be attained, namely, the principle of settlement by mutual agreement, and as, in this dispute, the employers refused this method of settlement, the E.T.U., being willing to use it, found themselves thereby ranged alongside the E.P.E.A., who, up to that point, were little more than spectators. As, however, the E.P.E.A. members were about to be directly affected by the defensive action the E.T.U. was bound to adopt, it was reasonable that they should declare their decision that, as the employers definitely refused to be reasonable, against the advice of the Minister of Labour, they must not expect their staff men to exceed their ordinary duties and supervise (or, in other words, train) unskilled men who may be brought in to fill the places of the workers with whom their employers were in dispute, and some of whom they had unreasonably expelled.

This is not siding with the E.T.U.—it is adhering to principle, but it so happens in this case that the E.T.U. is also guided by the same principle. On another occasion it may be found that the employers wish to be reasonable: in that case they will find themselves side by side with the E.P.E.A., a position which could not be described as the E.P.E.A. siding with the employers.

Why your correspondents should consider it so dreadful to have the E.T.U. following the path of their own Association I am at a loss to understand, unless they are of that class which still considers it "infra dig." and "not respectable" to take a stand under any circumstances against employers, but never questions the "respectability" of employers who openly break agreements, and only pay such debts as they can be compelled to pay, namely, all advances demanded by large and powerful unions, whilst men not so placed, but in very many cases rendering the highest services, are told they ought to consider themselves lucky to get less than many labourers.

I have a suspicion that at least part of the outburst is probably due to a most unfortunate feeling for which the E.T.U. is, in the first place, to blame, and which many members of the E.P.E.A. have striven hard to remove. If, however, the E.T.U. would only realise that the large majority of E.P.E.A. men (in spite of a few odd black sheep) were their friends, better relations would result, and more progress be made.

Pollux.

October 4th, 1920.

[To say that the E.T.U. has adopted the policy of the E.P.E.A. is a notable effort of imagination. The E.T.U. started a local strike, without exhausting conciliatory methods, for the purpose of compelling a man to rejoin the union against his will. Is that the policy of the E.T.U.? When the lock-out was declared, the E.T.U. accepted arbitration on tactical grounds, to "nobble" the E.P.E.A.—and as the next move, attempted to bring about a strike in a wholly detached industry, in which it hoped to secure the support of the E.P.E.A.—but without a thought of going to arbitration with the employers. The E.P.E.A. Executive fell into the trap. It was a pretty piece of dust-throwing, which obscured the vision of the victims, and led them into the desired course under the delusion that they were following their own policy!

Our correspondent is equally naive; he says: "As the employers definitely refused to be reasonable, against the advice of the Minister of Labour, they must not expect their staff men to exceed their ordinary duties." This statement is packed full of unconscious misconstructions of fact. It assumes that employer A is employer B; it assumes that opposition to the advice of the Minister of Labour is necessarily unreasonable; it assumes that the "ordinary duties" of the staff men are restricted to the performance of certain technical functions, disregarding their higher duties to the public, which they have accepted by entering the public service; and it goes on again to identify the electricity supply employers with the manufacturers who had "unreasonably" expelled the workers. "Pollux" must be very artless to be so easily duped.—EDS. ELEC. REV.]

I think the whole trouble with the E.P.E.A. is that we have no brilliant speakers or writers, our best being only moderate. Another item is that we can never hope to get large and representative meetings, owing to the fact that either one or two shifts are on duty at the time.

I think our Executive Council ought to make more use of the Press, its own Journal, and the platform; if it cannot, then let's pay for someone who can.

I see there are a few letters upholding the attitude of the E.P.E.A., which include one from Mr. Jones, but I am sorry to say that, like many other E.P.E.A. matters, they are all far too tame. For goodness sake wake up! Lash out and put a bit of fire into your correspondence; there is plenty to kindle.

With reference to the various groups of senior engineers, these men are all known to the E.P.E.A., and can almost be counted on two hands. Some are men who are holding very high and responsible positions, others I may add are not touched by the salary schedule. They are far too intimate with the chiefs, and in odd cases I believe that peaceful persuasion is the cause of some of the letters being written, to give one the impression of a split in our ranks. In future correspondence I suggest that writers cut out Penistone and the E.T.U., as their trouble was not ours; we have a determined policy, and—who knows?—it may be directly against the E.T.U. next time.

The question is asked: "Why should the general public be made to suffer?" Well, we have to give pain to cure pain, and what we want is to stop strikes. Our policy is based on Whitleyism, which is the birth of a new Trade Unionism, a fact which has sunk into the hearts of many trade union official, who admit it is a splendid idea, especially if the findings of the National Joint Boards can be made law by Act of Parliament. If this is achieved, there will be no more strikes, and the general public will reap the benefit. This is our aim, but unfortunately our first test case has been wrongly interpreted.

If what I am told is correct, Sir Robert Horne agrees with us, and also admitted that we had played into the hands of the Government, and I further add from my own knowledge that the action of the E.P.E.A. stopped the strike from taking place.

E. P. E. Atom.

October 2nd, 1920.

[If A has an aching tooth, do we extract B's tooth in order to cure A?—EDS. ELEC. REV.]

Power Factor.

Will you permit me to reply to my critics?

My suggestion of charging on K.V.A.-hours was not intended to be perfect. I assumed from the articles and correspondence that some difficulty exists in charging for low P.F. The supply company would not be paid for power without generating it, as Mr. Dorey states, for I distinctly stated that the price should be based on the P.F. of the system, not on the assumption that in giving K.V.A. the company is giving KW. Of course, the low P.F. customer would pay more and so be induced to "pull up his socks"—the high P.F. customer benefiting until the general improvement brought the P.F. up to his level and the price per K.V.A.-hour increased accordingly. If there is no difficulty in accounting for P.F. when charging, there is nothing more to desire. If a customer prefers low P.F. supply, give it to him and charge accordingly.

Mr. E. F. Smith gives me a heavier task, but I still maintain that a "wattless current" can exist. Probably the term is an abbreviation of the term "wattless component of the resultant current." Apart from that, the term "wattless current" is in order when speaking of R.M.S. values, as the total power resulting from the current acting with the pressure, over the cycle, is zero. I appreciate Mr. Smith's explanation of the effect of the lagging or leading of the current, on the power, though it may be found in text-books, but he does not show any increase of current due to the low P.F., which is the point at issue. The plant as it works at lower P.F., for the same work done and same power current, assuming the same efficiency, does give rise to an "extra" current which can be shown easily on an A.C. ammeter in the form of the effect on the main or resultant current.

As an example, take the case of a condenser of high capacity and negligible resistance. To improve the argument, using Mr. Smith's words "wattless component," this is all there is, and yet it is "a current," and so I say a "wattless current" can exist as much as a "wattless component." Let us add to our condenser circuit across the same supply, but by separate leads, a resistance. This causes a current to flow in phase with the pressure. Now bind the leads together so that the resistance is across the condenser with common supply. Why should not the two currents still exist, in some way mixed, so that they can only be measured from their resultant effect? We measure current as one current, but that is no proof that only one exists.

May I ask Mr. Smith how "wattless component" of power can exist, as he states?

All honour to Mr. Dorey for striking the right note in—"wattless leading component" of the load is 200 K.V.A.—but load is a doubtful word, as it usually denotes power and A stands for amperes, that is current, so why say component at one time and current at another? I took Mr. Dorey's terms broadly, realising what he meant. How many eminent writers use the term "magnetising current" not component? In talking of my "weird" current I did not say it comes from nowhere, and my statement that it causes slight losses was not in opposition to the statement that the "wattless current" itself takes no power, but in some way causes a "losses current." I should much appreciate a detailed scientific explanation of how this extra loss develops. Considering the case of the condenser shows the idea more clearly and avoids the complication due to resistance.

However, it remains for me to be my own critic. According to our accepted ideas of electrical power, a current "wattless" over a cycle combines with the pressure, and does give a power alternation of double the frequency of supply, which in mean effect is zero or "wattless." In this respect my criticism of Mr. Turnbull was wrong, and I regret the same, but the magnitude of this power is not proportional to the "wattless" current, and does not follow its alternations, but depends on the extent to which it coincides with the value of the pressure at any moment, and when the current is a maximum there is no pressure, and so for that instant there is, even in the cycle, a real "wattless current." So when this current "surges back on the generator," for half a cycle it is of opposite sign to the pressure for ¼ cycle and returns power and the same sign for the other ¼ cycle and takes power, and yet is surging back all the time. Similarly when the current comes from the generator during the other half-cycle there is power both ways. In this way I modify my criticism of Mr. Turnbull's statement, and would point out that that was the sole purpose in view in my letter, and I was not endeavouring to explain what P.F. is, as Mr. Smith evidently thinks.

I should much appreciate an explanation of the effect on the plant of this double frequency power as apart from the current itself, and thank Mr. Turnbull and Mr. E. F. Smith for leading me to such an interesting question. I do not wish to be dogmatic, and insist that there are several currents, but there are several distinct phenomena either of a current or pressure nature which merge. It is often more convenient to consider one current and several pressures. In conclusion, may I suggest "quadrature" current for "wattless."

Chas. H. Harvey.

Ponders End,
September 19th, 1920.

BUSINESS NOTES.

Dissolutions of Partnership.—James E. Sayers and Caldwell, consulting engineers and electricians, 190, West George Street, Glasgow.—Messrs. J. E. Sayers and J. Caldwell have dissolved partnership, the latter retiring. Mr. Sayers will continue the business in his own name, and will attend to debts, &c. Mr. Caldwell will carry on business on his own behalf at Parliament Mansions, Victoria Street, London.

Carrack & Cass, electrical engineers and contractors, 6, Park Place, Leeds.—Mr. J. W. Carrack and Mr. W. H. Cass have dissolved partnership. Mr. J. W. Carrack will attend to debts and continue the business.

Trade Announcements.—The A and A Electrical Co., Ltd., are now carrying stocks at their Manchester Branch, 2-8, Shudehill.

Messrs. Ward & Goldstone have just opened a branch for South Wales and the South and West of England at 71, Old Market Street, Bristol. The branch consists of stores, offices, and showrooms, and good stocks are held.

Company Liquidations.—E. Coates & Co., Ltd., mechanical and electrical engineers, Craven House, Kingsway, E.C. —At a meeting of creditors held recently at 95A, Chancery Lane, London, W.C., it was reported that the company had gone into voluntary liquidation, and had appointed Mr. G. C. Johnson to act as the liquidator. No statement of affairs was submitted by the liquidator, but in answer to a question, he said that the liabilities amounted to about £4,000. So far as the assets were concerned, they consisted almost entirely of book debts, the amount of which was at present unknown. The liquidator gave it as his opinion that the assets would not produce sufficient to discharge all the liabilities in full. The company was registered on December 7th, 1918, with a nominal capital of £10,000, to acquire and take over an existing business. The purchase price was fixed at £9,198, which was satisfied by the allotment of 3,000 fully-paid shares of £1 each, and the balance was paid in cash. The company also undertook to discharge any liabilities which existed at the time. The business carried on appeared to be that of agents selling abroad. During the first 12 months the company traded at a small profit, but since then heavy losses had been made through bad debts in Belgium and various Continental countries. The principal creditors were Messrs. Buckley, of Birmingham, who were interested for about £1,600, and who proposed a resolution in favour of a nominee of the creditors being appointed as liquidator. The resolution was eventually carried, and a committee of inspection of the principal creditors was also nominated.

Electric Supply Co. of Western Australia, Ltd.—Meeting of creditors, October 13th, at the offices of the British Insulated and Helby Cables, Ltd., Lennox House, Norfolk Street, Strand, W.C. Liquidator, G. Saies.

Catalogues and Lists. — The British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 2,131, giving illustrations and full details of synchronous motors and condensers, with curves and diagrams.

Foster Engineering Co., Ltd., Morden Works, Wimbledon, S.W. 19.—A catalogue (16 pp.) of transformers, single and three-phase, oil and air-cooled, and transformer switch-fuse sets, &c. Fully illustrated and priced.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E. 15.—Leaflet illustrating and describing an unspillable accumulator inspection lamp.

Messrs. J. Beardshaw & Son, Ltd., Baltic Steel Works, Sheffield.—Illustrated leaflet dealing with profile steel of various sections.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Leaflet V 2,340, giving an illustrated and priced description of the "Time Saver" electric washer and wringer.

Messrs. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, W. 8.—A show-card (19½ in. × 12½ in.) bearing a tasteful design advertising "Excel" lamps. Also an illustrated and priced leaflet dealing with "Excel" lamps of various types.

Athol Engineering Co., 9, Peru Street, Higher Broughton, Manchester.—Sheet C 2, a leaflet giving sizes, weights, and prices of transparent polished sheet celluloid.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham.—An illustrated and priced sheet of electrical accessories, including switches, fuses, motor starters, wires, and cables. Also leaflet dealing with "Osram" lamps.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C. 2.—Two priced and illustrated booklets—Bulletin 28 S, "Estimates for X-Ray Installations," giving very full details of many types; and Bulletin 29 S, "Diathermy Apparatus," with an introductory paper on the use of electricity to raise the temperature of the body in the treatment of disease.

Messrs. F. J. Shenton & Co., Ltd., 68 and 69, Shoe Lane, E.C. 4.—A 6-page list giving prices of switches, distribution boards, lampholders, adaptors, cut-outs, cables, &c.

Messrs. A. Wild & Co., 51, Great Dover Street, S.E. 1.—Price list of tanned leather, raw hide, balata, cotton and hair belting and hydraulic leathers and pump cups.

Messrs. Hyde & Thomson, Ltd., White Buildings, Fitzalan Square, Sheffield.—Stock List, October, 1920, giving details of "Rhodes" motors, for which the firm are sole agents. Delivery dates are stated in every case.

The Cambridge and Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W. 1.—List No. 191 (16 pp.). A well-illustrated description of "Cambridge" potentiometers and accessories, including standard shunts and thermo-indicator test box. Also the official list of instruments exhibited at the Engineering Exhibition, Olympia, which is an illustrated summary of the most important industrial instruments manufactured by the company.

Messrs. Drake & Gorham (Wholesale), Ltd., 67, Long Acre, W.C. 2.—Pamphlet No. 289 (5 pp.), describing and illustrating the "Apex" switch; priced. Pamphlet No. 297 (10 pp.), an illustrated and priced catalogue of tungsten lamps, reflectors, lanterns and fittings; and Pamphlet No. 298, "Electric Fires" (24 pp.), dealing with many types of fires, cookers, and other domestic electrical apparatus; a separate price-list is issued with this pamphlet.

Trade Conditions in South Africa.—The general managers of the Standard Bank of South Africa supply the following information regarding trade conditions throughout the Union:—Except in Rhodesia, where trade continues good, business generally is sluggish. Wholesale merchants report that trade is quiet. Owing to the irregularity of shipments, orders placed 18 months ago are only just coming forward with recent indents, thus adding to the difficulties of importers. The retail trade generally, except at Durban, has had a set-back. Owing to the difficulties of realising produce, the purchasing power in the country districts is restricted. There is a shortage of labour in the coal mining and sugar industries. Business in the iron and steel trades is quiet, difficulty being experienced in obtaining delivery of certain material, particularly plates. The prices for galvanised iron are below the cost of importing. Hardware supplies are not arriving. Electrical goods of all kinds are in stock, but business is very quiet. Business in motor cars is dull, some markets appearing to be overstocked. Owing to the excellent crop prospects, there is hope of improved general business conditions by the end of the year.—*Reuter's Trade Service* (Cape Town).

E.P.E.A. Schedule.—Midland Undertakings.—Pending the formation of District Joint Boards for No. 5 and No. 7 Area, informal meetings between representatives of the undertakings and representatives of the E.P.E.A. are being arranged to deal with the schedule of salaries for the technical staff. In No. 7 Area a meeting was held on Thursday, October 7th, at the Guildhall, Nottingham.

The dispute between Worcester Corporation and the E.P.E.A. has been settled by the Corporation agreeing to adopt the schedule of salaries, subject to the decision of District Joint Board upon outstanding matters.

A meeting of representatives of electricity undertakings in Lancashire, Cheshire, &c., held last week, refused to adopt the proposed new scale of salaries for technical members of the staffs from the National Joint Board, and decided to frame a scale of their own.

The French Telephone Industry.—The shareholders in the Société Industrielle des Téléphones have sanctioned an increase in the share capital from 18,000,000 to 36,000,000 fr. It was explained at the recent meeting that additional capital was required owing to the great augmentation in the cost of all materials, the desire to develop manufacturing, and the necessity for erecting new workshops provided with modern equipment.

Lamp-Makers' Wages.—The *Daily Herald*, on October 5th, published the following:—"A new demand for women workers in the electric lamp-making industry, which will also apply to women employed in the manufacture of electric accumulators, has been formulated by the National Federation of General Workers, and the National Federation of Women Workers. The demand is for a minimum weekly wage of 50s. for 18 years and over, 38s. for those under 18, a percentage increase for pieceworkers, and a week's annual holiday with pay. Separate application is to be made to the Electric Lamp Manufacturers' Association, and the British Electrical and Allied Manufacturers' Association forthwith."

Dutch Capital Augmentation.—The share capital of the Hengelosche Electrische en Mechanische Apparaten Fabriek (Heemay), of Hengelo, which now amounts to 5,000,000 florins, is being increased by the issue of new shares for 2,250,000 fl. at the price of 106 per cent. It is explained that the additional capital is required, owing to the full influx of new orders during the past half-year and the extension of the works and warehouses. At the same time the articles of association are being modified so as to raise the nominal share capital to 10,000,000 fl.

For Sale.—The Crown Agents for the Colonies invite offers for six 5-kw. and six 10-kw. single-phase oil-insulated transformers. By order of Messrs. Pritchett & Gold and Electrical Power Storage Co., Ltd., owing to the premises having been disposed of, Messrs. Bradshaw, Brown & Co., will sell by auction on October 19th the surplus plant and machinery at Greville Works, Ashtead, Surrey. For particulars, see our advertisement pages to-day.

Inquiries.—Makers of the "Sovereign" dry cell are asked for; also British agents for "Condensite."

Book Notices.—Starting this week, the *Technical Review* will in future appear weekly, instead of fortnightly; 500 additional sources of information have been added to its list during the past eight months, the staff of abstractors has been enormously increased, and the greater quantity of matters calls for additional space. The price per issue will not be changed.

Conquest for October—completing the first volume—contains articles on the working of a London telephone exchange, by M. Egan; a device for artificial respiration used by the London Fire Brigade with success; and the gas turbine, by J. D. Troup.

"Welfare Work." Vol. I, No. 9 (16 pp.).—The September number of the *Journal* of the Welfare Workers' Institute contains an article on welfare workers' training and notes on welfare work among the Scottish fisher folk.

The *Illuminating Engineer* for July, just received, announces an increase in price from 1s. 3d. to 1s. 6d. per copy.

"The Bennis Steam Tables" (12 pp). Ed. Bennis & Co., Ltd., 28, Victoria Street, S.W. 1. Price 1s. 6d.—Containing general information and a set of seven tables, including factors of equivalent evaporation, according to gauge pressure, initial temperature of water, and superheat and total heat and temperature of saturated steam at given gauge pressures.

Engineering Supplies for Australia.—The Department of Overseas Trade has received a communication from the Manufacturing Engineers' Association of Australia, Melbourne, to the effect that they are interested in particulars of machine tools, drills, cutting wheels, and milling cutters, and all manufacturing engineers' stores and supplies. They would value copies of United Kingdom manufacturers' catalogues, together with prices of machinery required in the equipment of their factories. Such catalogues, which should be forwarded direct to the Association, would be included amongst the books in the library of the Association, where they would be available for reference by members.

Cookery and Food Exhibition.—The twenty-fifth universal Cookery and Food Exhibition was held at the Royal Horticultural Hall, Westminster, from September 27th to October 1st. In spite of the big advances recently made in electrical cooking apparatus, the actual food exhibits were cooked chiefly by gas and oil. There were only two exhibitors of electrical manufactures—Carbon Company and the Edison Swan Electric Co. Demonstrations were carried out by the former company on a small combination cooker with two side and one top elements, making a total load of about 1,250 watts. These elements were of a standard type easily replaceable, and another feature was the accessibility of the wiring. On its main stand the company had a large 22-kw. double-oven roasting and baking range with three-heat controls for all elements, and a fuse and pilot lamp to each circuit. Another smaller cooker also appeared on this stand. All the exhibits were very attractive in appearance, being highly finished. The Edison Swan Co. exhibited a collection of small devices—electric rings, kettles, stoneware utensils, toasters, &c. The main features were a three-gallon urn, and an electric fish fryer consisting of a stand containing a 5·2-kw. element in two parts, grid, drip pan and frying basket. The control board was fitted with two rotary switches giving seven separate degrees of heat. The Artofex Engineering Works, Ltd., had a variety of kneading, mixing, slicing, and refining machines belt driven by a 3-h.p. motor, as well as a motor-driven coffee mill direct coupled.

Department of Overseas Trade.—The Board of Trade announce that Mr. G. T. Milne, O.B.E., has been appointed H.M. Trade Commissioner in London, stationed at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1. Mr. Milne recently vacated the post of Commercial Secretary for Cuba in order to take up the appointment in the Trade Commissioner Service at Headquarters. Mr. Milne held the post of Trade Commissioner in Australia from 1913 to July, 1918, when he was transferred to Montreal as H.M. Senior Trade Commissioner in Canada.

Recorder Contracts.—The Lea Recorder Co., Ltd., of Manchester, have recently executed contracts for their recorders for the purpose of measuring steam consumption or condensate for steam turbines at the following electricity works:—Paisley, Wrexham, St. Helens, Great Yarmouth, Whitby and Seville, also Cairo wireless station. Repeat orders have been received from the London Electric Railways and from the following electricity works:—Lancashire Electric Power Co. (Radcliffe), Accrington, West Ham, Shanghai, Durban, Kilmarnock, Sheffield, Liverpool, Lincoln, Dundee, Bolton, St. Marylebone, Halifax, and Melbourne.

German Export Duties Reduced.—The export duties have been reduced on numerous articles, including electric lamps of all kinds, insulating material, carriages, steam engines, sewing, embroidery and seed machines, steam and gas turbines, bookbinding machinery, blowing machinery, fire engines, and a large number of chemical products.—*Reuter's Trade Service* (Berlin).

Trade with Canada.—The British Government Trade Commissioner, Mr. Frederick Field, is leaving Toronto on October 8th on an official visit to the United Kingdom to confer with the Department of Overseas Trade in London and with Chambers of Commerce, manufacturers and merchants throughout Britain.—*Reuter.*

The Birmingham Fair, 1921.—We are informed that space is letting rapidly for the Birmingham Section of the British Industries Fair, which takes place early next year. As our readers will remember, it was at the Birmingham Section this year that electrical and engineering exhibitors displayed their goods, and that will be the experience in 1921 also, because the arrangements are to be practically the same. We understand that the greater readiness of manufacturers to take space, as compared with a year ago, is due to the fact that they have now greatly increased their production of goods, and have worked off many of their standing contracts, and will be eagerly on the look-out for new business. There is no question about the value of these Fairs (London, Birmingham, and Glasgow) as occasions when manufacturers can meet buyers from other parts of the world.

The Birmingham Section is again being organised by a Joint Council of the Birmingham Corporation and the Chamber of Commerce, and it will again be held at Castle Bromwich. Mr. Charles Stanley will once more be the general manager. The exhibits will comprise brassfoundry of all kinds; tools; hollow ware; cooking and heating stoves; mechanical rubber goods; tubes and fittings; ferrous metals and alloys; general hardware; belting; cycles and motor-cycles; accessories for cycles, motor-cycles, cars, and aeroplanes; paints, colours, varnishes, &c.; ropes (wire and fibre), &c. Full information as to space available, &c., can be obtained on application to the General Manager, British Industries Fair (Birmingham), 1921, Chamber of Commerce Building, 95, New Street, Birmingham.

The Copper Trade in Japan.—The copper trade in Japan is at present at a standstill, principally owing to the absence of demand, both at home and abroad, following the recent slump. Very little export is reported in spite of the fact that quotations here are lower than those prevailing in foreign countries. The question of exchange is also working against Japan. There has been no noticeable change in production for the past two or three years, whereas some 30,000 tons have been imported into this country. The present stocks on hand are said to amount to 25,000 tons. In ordinary circumstances it is a general rule that the demand for copper exceeds the supply, the consequence being that some difficulty is experienced when purchasing, except three months forward or longer. The Japan Copper Sale Association has decided to export about 10,000 tons to Europe and another 10,000 tons to Asiatic countries with a view to reducing the heavy stocks which are keeping down the tone of the market. Ten per cent. of the 10,000 tons for Europe will be consigned to London. All the above exports will be made in a semi-refined condition, and shipped to consumers direct. The price agreed upon is put at from 45 yen to 44 yen per picul. A large demand is anticipated from America in consideration of the cheaper price now ruling in Japan. Further orders to the extent of 12,000 to 13,000 tons are also shortly expected from China. The Association is anxious to get rid of the heavy stocks now glutting the market as fast as possible, and with this end in view, it is prepared to entertain offers for export even at a loss.—*Reuter's Trade Service* (Tokyo).

Tasmanian Hydro-Electric Loan.—In his budget speech in the Tasmanian Parliament, the Treasurer said it would be necessary to approach the London market shortly for a loan mainly for hydro-electric and other public works, while the people of the State would be expected to lend the funds necessary to meet the State's other requirements.

New French Company.—La Société Electrique Koda is the name of a new company which has lately been formed in Paris (218, Faubourg St. Honoré), with a capital of one million francs.

Co-operative Electrical Repairing.—A company in which all the workmen are shareholders and ex-service men, has been formed at Sunderland for the repair of electrical machinery. A branch is also being established at Newcastle-on-Tyne.

Argentine Customers.—The names of the following firms in Buenos Ayres are given in a German newspaper as buyers of motors, measuring instruments, electro-medical apparatus and installation materials:—Misch, Pensa y Notario, Calle Bolivar 385; Juan B. Scapusio, Calle Carlos Pellegrini 898; Pratt y Cia, Calle Sarmiento 636; F. Walter y Cia, Calle Venezuela 400; Heinlein y Cia, Calle Avenaida de Mayo, 1402; P. Luis Alberto Meincke, Calle Almirante Brown 1434; and Magnocavallo y Bono, Calle Corrientes 1731, all of Buenos Ayres.

Electricity Supply Commercial Association.—A mass meeting is to be held at Caxton Hall, Westminster, on October 18th, when the general secretary, Mr. G. R. Smith, will address the audience. Tickets can be obtained from the Hon. Sec, London Division, Mr. J. C. Adams, Longmore, Horsham Road, Esher. As the Association is represented on the National Joint Board for the Electricity Supply Industry, it is obviously the body to which those engaged in commercial and clerical occupations in that industry should attach themselves.

Belgium.—A new company, the Etablissements de Man, has just been established in Antwerp for the manufacture, repair, erection and trade in all kinds of electrical apparatus, more especially those employed in medicine, telephony and wireless telegraphy. Its capital is 1,000,000 fr.

Small Searchlights.—Having acquired the drawings, patterns, and stock of the late firm of Messrs. Arthur Lyon and Wrench, of Westminster and Willesden, THE LONDON ELECTRIC FIRM, of Croydon, is in a better position for supplying searchlights of this class. These have been largely supplied for Naval use, for daylight signalling, and for landing lights for aerial navigation; also for mercantile marine work, for motor boats, small steamers, pleasure yachts and cruisers. Foreign, as well as Home, Government Departments have made use of these handily designed outfits.

Inter-Trade Union Dispute.—An agreement has been reached at a conference in London with regard to the South Wales dispute as to membership of the Iron and Steel Trades Confederation and the Electrical Trades Union in that area. The matter arose over the case of a man at the Port Talbot steel works, employed as an electrician's assistant. It has been agreed that the man concerned shall transfer his membership to the Iron and Steel Trades Confederation. As to the general position of the membership of the two Unions in other parts of the country, it was decided that a national conference should be held to arrive at a working arrangement.—*Manchester Guardian.*

New Uses for Rubber.—In connection with the intention of the Rubber Growers' Association (Inc.) to award £5,000 in prizes for ideas and suggestions for extending the present uses or for encouraging new uses for rubber, it should be stated that the closing date is December 31st next. Conditions governing the competition may be obtained from the Rubber Growers' Association (Inc.), 38, Eastcheap, London, E.C. 3.

The Cost of Living and Industrial Unrest.—At the National Conference on the High Cost of Living . . . . the proceedings, apart from the suggestive speech delivered by Mr. W. W. Paine, of Lloyd's Bank, were disappointing. Mr. Paine apparently preferred to face the labour problem boldly. He pointed out that improvement in the condition of the working classes could only come about from increased wealth to be produced by greater efficiency and steady work. Goods and services alone formed the fund on which cheques could be drawn. To his certain knowledge, he added, sectional strife was at present involving this country in huge losses of contracts and orders, which, if they had come here, would have helped to increase the fund of real wealth. If this sort of thing continued, a few more years of strife would leave little to quarrel about. Few will, therefore, dispute Mr. Paine's declaration that we have got to arrive, in the future, at some equitable plan for the division of the product of industry between the factors which produced it—brains, labour, and capital. In order to arrive at the principle of such a plan, which, of course, would vary in its application to different industries, Mr. Paine suggested the appointment of a Royal Commission of Inquiry. Such an inquiry would be wholly beneficial, even if it only succeeded in discrediting the various wild theories which are current as accepted truths in too many quarters. The inquiry would have to be held in public, for it would outstrip in importance and value any inquiry of the kind in recent years. The suggestion merits the serious consideration of the Government. —*The Times.*

Outing.—In celebration of recent developments in their activities, the directors of Messrs. Palmer, Riley & Co., electrical dealers, of Accrington, recently organised for their employés a motor trip to Blackpool and Fleetwood. High tea was served at Norbreck Hydro, where the guests were welcomed by Mr. W. Palmer (managing director); Mr. T. B. Hoyle (sales manager) and others also spoke.

Unemployment.—*The Times* correspondent reports that on Saturday last, Messrs. Steel, Peech & Tozer, Ltd., of Sheffield, gave seven days' notice to 1,000 of their workmen, owing to shortness of orders. According to the same paper, Messrs. Ruston and Hornsby's motor manufacturing works at Lincoln gave notice to 400 employés not to resume work until October 12th. At Coventry there are a good many men of the motor and general engineering trades out of work. In the Black Country hundreds of operatives were discharged last Saturday, owing to an almost total lack of orders, the effect of foreign competition.

Pity the Poor Editor.—Getting out a newspaper or monthly publication is no picnic, says an American journal. If we print jokes, folks say we are silly—if we don't they say we are too serious. If we publish original matter they say we lack variety—if we publish things from other papers, they say we are too lazy to write. If we don't go to church we are heathens—if we go we are hypocrites. If we stay in the office we ought to be out rustling for news—if we rustle for news we are not attending to business at the office. If we wear old clothes we are slovens—if we wear new clothes they are not paid for. What in thunderation is a poor editor to do anyhow? Like as not someone will say we swiped this from an exchange. So we did!—*Financial Times.*

American Foreign Trade.—Mr. Jas. Farrell, president of the U.S. Steel Corporation, urges an expansion of American foreign trade as one real remedy for the business depression which still hovers over the country. In this way she will dispose of her excess production. He appears to recognise, however, that the U.S. traders will require Government assistance if they are to overcome the handicap imposed by the fact that other nations are older in the field, and are better placed in regard to cables, coaling stations, banking facilities, harbour privileges, &c.

Wages of Steel Workers.—Under the sliding scale adopted by the Board of Conciliation and Arbitration for the manufactured iron and steel trade of the North of England, it is announced that there will be another advance of 15 per cent., bringing wages up to 230 per cent. above the standard. In the past six months the men have received 65 per cent. advance.—*Daily Telegraph.*

LIGHTING AND POWER NOTES.

Barnstaple.—Loan.—The Town Council has applied for a loan of £4,145 for the purchase of a 500-kw. set.

Birkenhead.—Supply Shortage.—The consulting electrical engineer to the Birkenhead Corporation suggested that the Council should communicate with the Electricity Commissioners and point out that neither Liverpool, Birkenhead, nor Wallasey could offer an electrical supply at the moment, and so far as the Council was able to gather, there was no prospect of obtaining a supply from the Mersey Power Co. within 18 months to two years, and ask the Commissioners, under the circumstances, whether they could suggest any other source of supply. The Electricity Committee recommended that in the event of the Commissioners being unable to suggest where the Council could obtain an immediate supply, the Council should ask for a further extension of time for the carrying out of the compulsory works.

Bolton.—Extensions Approved.—The Electricity Commissioners have given their consent to the installation at the Back-o'th'-Bank generating station of one 6,000-kw. turbo-alternator, and two 12,000-kw. turbo-alternators and necessary auxiliary plant, and to the construction of the necessary buildings for the plant.

Bristol.—Loan.—The City Council is applying for sanction to borrow £46,110. £36,000 is the estimated cost of providing house services for the next three years, and £10,160 is required for additional coal-handling plant at the Feeder Road works.

Caerphilly.—The Urban District Council has applied to the Electricity Commissioners for a special order to authorise the Council to provide and distribute electrical energy within the urban district.

Cannock.—House Lighting.—Tne Urban District Council has arranged with the Wolverhampton Town Council, under a guarantee of £130 per annum for three years, for a supply of electricity for lighting the new houses at Bushbury.

Chile.—Water-Power.—Don Eliodoro Yánez, President of the Sociedad de Fomento Fabril (Industrial Development Society), has addressed a letter to the Ministro de Industria, advocating a Governmental inquiry into the water resources of the country. Chile, he says, a well-watered land, is destined for a great industrial future, by reason of its numerous waterfalls capable of being utilised for generating electricity. The one thing needful is that a Government department take in hand the work of compiling exhaustive hydrographic statistics of each river, especially in the central provinces, which may be placed at the service of all and sundry desirous of initiating new industries in the country. Chile's wealth in water power is known abroad, he says; but such statistics as have been made by foreign firms and companies are withheld from the general public. For this reason he asks that a sum not less than 80,000 pesos be placed on next year's estimates, so that the water department of the Public Works may make the needed hydrographic survey of the principal rivers and their feeders in the central zone of the national territory.

Continental.—France.—A conference of 70 communes of the department of the Allier has nominated a Commission to devise means for establishing an electric distribution service to supply electricity for agricultural purposes and household uses. A lengthened period of drought has had the effect of partly paralysing the electric supply furnished by the Forces Motrices du Vercors to 104 communes in the departments of the Drôme, the Isère, the Ardèche, and the Loire, owing to shortage of the water flowing in the River Bourne, which is used for generating purposes. The company has had, in consequence, to suspend its supply to industrial consumers one day in two.

A huge scheme for the utilisation of the motive power of the Rhine, in connection with a series of electric generating stations in parallel, has been devised by a number of Chambres de Commerce and the Société Industrielle de l'Est, and the Conseils Généraux of the Departments interested will be shortly called together to deliberate on its execution. The scheme contemplates the building of a dam at Kembs, near Huningue, where the mean flow of the river equals 700 to 800 cubic metres per second, yielding some 100,000 h.p. at high water and 50,000 h.p. at low water. Below this dam seven similar ones are projected, the volume of water growing as Strasburg is reached, where it rises to about 1,000 cubic metres, the height of each fall being 13 metres. The total power thus available reaches 1,000,000 h.p. at high water and 500,000 at low water. To build these seven dams and their respective stations the 12 Chambres de Commerce of the region of l'Est propose to form a trust, to be constituted under the style of the Compagnie Nationale du Rhin, on lines similar to those adopted for the Compagnie Nationale du Rhône. Appeal will be made, first, for the co-operation of the Chambers of Commerce of Alsace and Lorraine, and especially of that of Strasburg; then to the *départements*, through their *conseils généraux*, and, lastly, to the big towns of the region, all interested in the realisation of the scheme. The estimate of the outlay involved for these works totals a milliard of francs.

Sweden.—The Swedish Government Operation of Water-power Sites reports a gross income for 1919 amounting to 13,897,649 crowns, and expenditures of 7,622,750 crowns. Nearly all the water-power plants now in operation show a profit to the Government, and most of the expenditures are on account of additions and new construction work on power sites that have not yet been completed.—*Commerce Reports.*

Deal.—Bulk Supply.—The Ministry of Transport has informed Deal Town Council that unless it is satisfied that the Electricity Co. has arranged to take electricity in bulk from some neighbouring source, no further extension for carrying out the order will be considered.

Dublin.—Electric Cooking.—The city electrical engineer (Mr. Kettle), under the authority of the Electricity Committee, has been giving experimental cooking demonstrations in the houses of consumers. The amount to be expended under this head is limited to £100.

Dundalk.—Year's Working.—It was reported at the Council meeting that the accounts of the Electricity Committee for the financial year ended in March last showed a net profit, after meeting charges of interest and sinking fund, of £602. The negotiations with the Great Northern Railway Co. (Ireland) as to supply of electricity to workshops, &c., resulted in acceptance of the company's offer of 1·9d. per unit.

Dundee.—New Plant.—The Electricity Commissioners have sanctioned the installation of an additional 10,000-kw. turbo-alternator at the Corporation's generating station at Carolina Port. Work of a preliminary nature will be put in hand immediately.

East Ham.—Linking Up.—The Electricity Committee recommends that the sanction of the Electricity Commissioners be obtained to the borrowing of £19,712, which is the Council's share of the cost of linking up with West Ham, Ilford, and Barking. The plant to be purchased consists of one 1,500-kw. converter with the necessary high and low-tension switchgear.

French Indo-China.—Water Power.—It is stated that considerable water power is available in the French colony of Indo-China. Among the falls which can be easily harnessed is that of Khône, on the River Mekong, and the Sambor on the same river; the falls of Goga, Lieu Khan and Trian on the Donai River, and the falls of Chobo on the Noire River. At the last-named falls a station is contemplated of 50,000 h.p. capacity, which, after supplying 5,000 h.p. to a zinc works, will provide power for irrigation in the lower reaches of the Rouge River, the surplus being distributed to local industrial consumers.

Frodingham.—Terms of Purchase.—The Urban District Council has inquired from the Frodingham Iron and Steel Co., Ltd., upon what terms it would be prepared to sell the electricity distributing plant in connection with the Brumby and Frodingham scheme.

Guildford.—Purchase of Undertaking.—The Town Council has applied for a loan of £80,000 for the purchase of the undertaking of the Electric Supply Co., and extensions, estimated at £20,000, after the date of purchase.

Halifax.—Loan Sanctioned.—The Corporation ha received intimation from the Electricity Commission that that authority has agreed to sanction the borrowing of the provisional sum of £119,769, in respect of the Corporation's application for power to borrow £170,000 for purposes of the local electricity undertaking.

Ilford.—House Services.—The Urban District Council is to supply electricity to the new houses on Townswood Hill by means of an overhead main, and to meet the development of the Cranbrook Road district a new feeder and house services are to be provided at a cost of £10,000.

Leyton.—Loan Sanctioned.—The Urban District Council has received sanction to a loan of £5,000 for mains, and £2,000 for services. The sum applied for for mains extensions was £10,000.

Liverpool.—Loan Sanctioned.—The Corporation has received sanction from the Electricity Commissioners to borrow £32,500 on account, for the extension of electrical mains in connection with the city housing schemes. The amount asked for was £45,000.

London.—Barking.—An application has been made to the Commissioners by the County of London Co. for sanction to the erection of a large power station in the Barking district. The Conference of London Electricity Authorities has been in communication with the London County Council and also with the other London companies with regard to this matter, and it has now been decided jointly to oppose the application on technical grounds, and counsel have been instructed to oppose on behalf of the Conference, &c., at the public inquiry which is to be held

Manchester.—Bulk Supply.—The Electricity Committee has provisionally arranged to meet the demands of the Lancashire Electric Power Co. to the extent of about 20,000 kw. from the power station now in course of erection at Barton. It is expected that the demand will be met by the winter of 1922-23.—*Daily Dispatch.*

Morecambe.—Electricity Charges.—A proposal by the Electric Light Committee to charge for electricity for lighting and power at a flat rate of 8d. per unit, was defeated at a Council meeting by an amendment put forward by the vice-chairman of the Committee.

Newhaven.—Electricity Supply.—The Brighton Town Council has informed the Urban District Council that it is unable to give the town a supply of electricity.

Newport.—Extensions.—The Commissioners have now advisedithe Corporation that they are prepared to sanction the first portion of the scheme (£139,550). It is anticipated that the rest of the scheme will be sanctioned as soon as the detailed information for which the Commissioners have asked has been submitted. The question of the generator has not yet been settled, but it is more than likely that this order will be placed on the Continent. The consideration of the condensing plant tenders has been deferred for the present. Messrs. Escher, Wyss' tender, in line with all Continental tenders, was very much lower than any British tender, and their steam consumption guarantees under full penalty the lowest. They are also prepared to accept the contract without the inclusion of any wages variation clause, and the rate of exchange is not to be taken into consideration; that is to say, it is to be a cash sterling contract; or, if the Corporation prefers it, on the basis of Swiss francs.

New Ross (Co. Wexford).—Public Lighting.—The Urban Council has accepted the Gas Co.'s tender of £8 15s. for lamps for public electric lighting.

Peterborough.—Loan.—The City Council has decided to apply to the Electricity Commissioners for sanction to borrow £32,777 for the purchase of a 3,000-kw. turbo-alternator from the English Electric Co., Ltd.

Portsmouth.—Year's Working.—The accounts of the electricity department, for the year ended March 31st last, show a total income of £91,685, as compared with £60,103 for 1918-19. Total expenditure amounted to £68,623, against £52,951, leaving a gross balance of £23,062 (£7,152). The payment of capital charges left a net profit of £3,375, as against £9,128 in the previous year.

South Africa.—Simons Town.—A public meeting of voters has authorised the Town Council to take steps to raise a loan of £10,000 to cover the cost of an electric light scheme. Mr. D. J. Hamlin, the town electrical engineer of Steelenbosch, is acting as consulting engineer, and arrangements have been made to obtain a supply in bulk from the Admiralty. It is proposed to charge the consumers between 8d. and 1s. per unit.

Southampton.—Year's Working.—The total revenue of the electricity undertaking, for the year ended March 31st last, was £111,992, as compared with £86,627 for the previous period. Working expenses totalled £86,714 (£63,258), leaving a gross profit of £25,278 (£23,369). The payment of interest and loan redemption charges left a net credit balance of £4,709, as compared with last year's figure of £6,029. The number of units sold rose from 9,424,829 to 10,570,248.

Stoke-on-Trent.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £10,000 for the provision of transformers, &c. The plant to be installed at the central power house is ready for erection, but the building extensions are not yet finished.

Twickenham.—Electricity District.—At a recent meeting of the Town Council, formal notice was read of the provisional determination of the London and Home Counties Electricity District by the Electricity Commissioners, which area includes Twickenham, and a communication from the Hammersmith town clerk explained that a conference of local authorities in London and Greater London owning electricity undertakings had been held. If the authorities not owning undertakings so desired, a conference of such authorities would be convened, with a view to their working in co-operation with the conference of authorities owning undertakings. The Council is to co-operate in the matter referred to.

Proposed Price Increase.—Colonel T. E. Ekin held an inquiry recently into the proposal of the Twickenham and Teddington Electric Light Co. to increase its charges to 1s. 2d. per unit. The original charge was somewhat below 7d.; the price has now risen to 10d. Although the company asked for 1s. 2d., and had given notice to consumers, it only proposed to charge 1s., and if the order was granted it would hold for 5 years.

Wimbledon.—Proposed Extension.—The Town Council has applied to the Commissioners for leave to extend the plant by the installation of a 3,000-kw. turbo-alternator.

Wrexham.—Bulk Supply.—Having been in communication with the North Wales Power Co., which expects to be in a position in 12 months' time to supply energy in bulk, to meet the town's requirements, at half the price the ratepayers are at present paying, the Electricity Committee has decided to hold up its own works extension scheme, which is estimated to cost £17,000, and for which borrowing powers have already been sanctioned.

York.—Hydro-Electric Scheme Delayed.—The City electrical engineer reports that owing to the wet season and the delay in obtaining material, the progress of the work in connection with the Linton Locks hydro-electric works has not been so good as could have been expected under better conditions. The excavations for the retaining walls of the head race are well in hand, and it is hoped to commence the concrete walls in a few days' time. The timber for the coffer dam has been received, and the tail race and coffer dam are in course of construction. The piling plant is expected to be on the site this week, and it is hoped that the concrete piles will be in position before the rainy season sets in.—*Northern Echo.*

TRAMWAY AND RAILWAY NOTES.

Ashton.—Tramway Extensions.—In view of the purchase of certain lengths of tramways now owned by the Oldham, Ashton, and Hyde Electric Tramways Co., the Ashton Corporation has entered upon an extension scheme involving an outlay of thousands of pounds. In addition to erecting a large shed adjoining the existing depôt in Mossley Road, the Corporation has acquired over a dozen new tramcars of the latest type, and has decided to build a new tramway office at an estimated cost of £4,000. The Corporation has also under consideration the laying of a double track between Ashton and Oldham, with a through service of cars between the two towns.—*Manchester Guardian.*

Austria.—An American engineer has just carried out a survey of the Austrian railway system, with a view to its electrification. He reports that it is the intention of the Government to develop the water power of those waterfalls capable of being utilised for the electrification of the railway lines situated in the hilly regions of the north-west. He points out that the conversion of the lines between Innsbruck and the Swiss frontier would mean a yearly saving of 150,000 tons of coal—an important consideration for Austria since the cession of her former coalfields to the newly-formed States. Austria does not seem able to finance these new schemes; but, according to the American engineer, the capital needed might be provided in America on a mortgage of the income from the working of the lines.—*L'Electricité.*

Birkenhead.—Year's Working.—The annual report of the Tramways and Motors Department for the year ended March 31st last, shows that the total revenue from the tramways was £148,179, as against £114,974 in the previous year. Working expenses totalled £100,476 (£69,249), leaving a gross balance of £47,703 (£45,725). The payment of capital charges left a net profit of £16,105 (£16,500).

Bradford.—Accident.—A railless car of the Bradford Tramways Department and a motor wagon collided in a thick fog last week, and both vehicles were damaged. Both drivers gave warning, but were unable to avoid the impact. On the car the cab and front of the chassis were considerably smashed, and the front axle and steering gear of the wagon were put out of action.

Dundee.—Traction Supply.—The Electricity Committee has agreed to provide power for the Dundee and Broughty Ferry Tramways at a charge of 1½d. per unit plus 10 per cent. It was pointed out that although this would bring in only a small profit, it would put the Council in a stronger position if and when the purchase of the tramway system was contemplated.

Gateshead-on-Tyne.—Fare Increase.—The Gateshead and District Tramways Co. announces an advance in fares as from October 4th, and claims to be the last undertaking to advance its charges. There had been a practically universal penny fare (with the exception of one extension), but under the new scale the fares will go up to 2d. (for 2½ miles), and on the extension to 3d. The company has placed orders for 12 new cars, and announces several track alterations, including a new line to connect two present routes. The company has purchased land adjoining the Gateshead depôt, and is arranging for the construction of workshops and car-sheds.

India.—Calcutta Strike.—On October 1st 1,800 drivers and conductors on the Calcutta tramways struck work, demanding a 50 per cent. increase in wages.—*The Times.*

Ipswich.—Breakdown.—Owing to the failure of the insulation of a 3,000-kw. generator, the whole of the tramway services were suspended on September 28th for 3½ hours. Supplies to a number of factories were also cut off for some time.

Italy.—Proposed Underground Railway.—The scheme for the construction of an underground electric railway, which was brought forward in 1912, when proposals were also invited from other countries, has now been revived by the Municipal Council of Milan. It was originally estimated that the project would involve an expenditure of 140,000,000 lire.

Liverpool.—Accident.—Through the trolley-wheel of an electric car becoming twisted in the overhead lines of a busy crossing, causing the wire to catch firmly in a notch below the wheel, there was a hold-up of traffic in one of the busy Liverpool streets last week. Before the car could be stopped the wire snapped and fell, and the trolley wheel was wrenched from its pole. At the point where the accident occurred, the overhead wires form an extensive network, and it was fortunate that greater damage was not caused.

Leeds. — Sleepered Track. — The Corporation has purchased a strip of land, which will be utilised solely for tramway traffic. The lines will be laid on sleepers above ground, in order to economise cost, as against the ordinary method of tramway track laying, and the cars in this area, where other traffic cannot go, will develop a higher speed than on ordinary routes. The Department contemplates laying another track of similar character between Hunslet and the new garden city of Middleton, and the same method of construction will be adopted wherever conditions permit in renewing or extending lines on the outskirts of the city.

Coal Transport.—The high cost of coal cartage in Leeds has raised the question whether coal transport by tramway for the general public could not be arranged. The tramway department has powers to carry coal, and already does carry coal and fireclay for the Leeds Fireclay Co., but has no power to erect coal staithes. It has been suggested that coal merchants, or consumers in co-operation with the merchants, in the various districts, might collectively erect necessary staithes, and the general manager said he saw no serious reason why tramway transport should not be arranged under such circumstances, though he had not had occasion to inquire deeply into the matter hitherto. It would require special cars, with facilities for loading from railway trucks, and discharging into the staithes. He suggested that owing to the extra handling, the idea would probably not be worth while for less than about 3-mile journeys.

London.—Stepney.—The Borough Council has been informed that the Minister of Transport has consented to the use of the overhead trolley system of electric traction on the portion of the London County Council tramways in Grove Road and West India Dock Road. The work will shortly be begun. Owing to a lengthy dispute between the Stepney Borough Council and the L.C.C. as to whether the overhead or underground-conduit system should be adopted (the L.C.C. insisting upon the former and the local authority on the latter) there has been no tramway service in this populous part of London since the horse cars were abolished many years ago.—*Daily News.*

District Railway.—It is announced that the agreements by which the Government undertook financial responsibility for the working of the Metropolitan District Railway have now come to an end.

Fare Concessions.—Lord Ashfield has pointed out, in a letter to Mr. G. H. Hume, late chairman of the L.C.C. Highways Committee, that although the "Underground" Companies have introduced a cheap mid-day fare on certain of their omnibus routes, they still consider this practice economically unsound. If, however, the experiment proves them wrong, they are willing to make a general extension of these concessions.

Increased Fares.—It is reported that the increased fares recently put into force have not had an adverse effect upon revenue. The return for the first week showed that receipts were greater than for the corresponding week last year, notwithstanding the fact that the latter was an abnormal one on account of the railway strike, with a consequent increase in the number of passengers.

Newcastle-on-Tyne. — Inquiry. — With a view to preventing overcrowding on the tramcars, Major G. L. Hall, R.E., who recently conducted an inquiry into the matter, made the following proposals:—(*a*) Regulation by the police of passengers at the times of big loads, into queues, and the erection of barriers similar to those used in London; (*b*) The exhibition of a conspicuous notice "car full," and the provision of a barrier which for the present at any rate, may have to be more substantial than a chain across the entrance, the removal of which will be under the conductor's control; (*c*) The co-operation of the police and of the tramway manager in ensuring that the load on cars is kept within a reasonable limit, more particularly in respect of regulating queues.

Twickenham. — Broken Guard Wire.—The trolley arm of a tramway car when passing under the railway bridge at the Green last week, left the conductor wire and struck a guard wire, which broke and fell across the live wire. In its fall the end of the wire fell into a passing motor-car, and several of the occupants received shocks. One man, who was riding on top of the tramway car, received a severe shock, and was rendered unconscious; he was removed to hospital.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Increased Rates.—The Australian House of Representatives has passed a Bill, says *The Times*, sanctioning increases in postal, telegraph, and telephone rates.

Canada.—New Wireless Station.—Preparatory to building a large wireless experimental station for communication between Canada and England, the Marconi Wireless Co. of Canada has purchased 23 acres of land about nine miles from Toronto. It is understood that this is the first of a chain of wireless stations with which it is expected to encircle the British Empire.—*Reuter's Trade Service* (Toronto).

France.—The submarine cable between Dakar and Conakry in French Africa has been interrupted, thus cutting off that region from Paris. In consequence, use has been authorised to be made of the line Douai to Lyons for private and press correspondence intended for Senegal and French Equatorial Africa.

The new rates, on telegrams inscribed "non taxés. Voie T.S.F.," will be:—Senegal, Haut-Senegal Niger, Soudan-Mauritanie (except Abar), Chinguetti, and Port Etienne, 1 fr.; offices in Abar, Chinquetti, and Port Etienne, in Mauritanie, 1.30 fr.; offices in Tchad territory, 1.60 fr.; Equatorial Africa, 1st zone, 2.75 fr.; 2nd zone, 2.50 fr.; 3rd zone, 3.70 fr.

Germany.—Wireless Extensions.—The German Postal Ministry is busy with a plan for extending the German wireless system throughout the country. At present, wireless stations for receiving and dispatching messages exist at Berlin, Breslau, Darmstadt, Dortmund, Frankfort o/M., Friedrichshafen, Hamburg, Hanover, Königsberg, Königswusterhausen, Constance, Leipzig, Stettin, and Dantzig. Receiving stations have now been opened at Brunswick, Breslau, Chemnitz, Cottbus, Darmstadt, Dortmund, Dresden, Düsseldorf, Duisburg, Elberfeld, Essen, Frankfort (Main), Halberstadt, Hamburg, Hanover, Königsberg (Pr.), Constance, Leipzig, Liegnitz, Magdeburg, Rostock, Stettin, and Stuttgart. Bavaria and Württemberg are to be linked up to the German wireless system. A wireless station has been erected in Stuttgart, and another will shortly be finished in Munich, while the Düsseldorf station is now working. It is intended to open stations in the district at present occupied, but the Inter-Allied authorities have provisionally withheld their consent.—*Economic Review.*

Hull.—Increased Charges.—The Corporation Telephone Committee has decided to increase its tariff to cope with its increased expenditure.

London. — New Exchange. — The Government has acquired a site in South Audley Street, near Grosvenor Square, for the purpose of erecting a telephone exchange to be known as "Berkeley," which will relieve the congestion at the Mayfair exchange.

Spain.—Wireless System.—The Compania Nacional de Telegrafia maintains control stations at Cadiz, Santa Cruz de Tenerife, Milenau in the Canary Isles, Cabo de Patos, Santander, Vigo, and Finisterre. It also owns stations at Aranjuez and Prat de Llobregat, near Barcelona. The Compania Nacional de Telegrafia Sin Filos is conducting experiments in wireless telephony. At the moment a military wireless station is being erected at Carabanchel, near Madrid, to carry on wireless telephony between Madrid and Tetuan, in Morocco. It is hoped soon to carry on wireless conversations between England and Prat de Llobregat.—*Economic Review.*

Sweden. — American Telephone Cable. — With reference to our note last week under the above heading, we are informed by the Western Electric Co. that the telephone cable which is to be installed between Stockholm and Goteborg is longer than was stated. We understand that the distance involved is something like 335 miles.

The Swedish Telegraph Department and Naval Staff have proposed the issue of a new order prohibiting foreign ships in Swedish territorial waters within a less distance than 10 nautical miles from a Swedish coast station from using wireless apparatus, except in cases of emergency, or when it is necessary to correspond with the nearest coast station.—*Reuter's Trade Service* (Stockholm).

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes.

Queensland.—November 24th. P.M.G.'s Department. Iron poles (schedule 506), protected cable terminals, cable distributing boxes (schedule 507).

November 30th. P.M.G.'s Department. Protectors (schedule 505). (September 24th.)

Brisbane.—December 9th. Department of Public Works. Seventy three-phase oil-cooled core type static transformers.

November 23rd. P.M.G.'s Department. Telephones and telephone switchboard parts. (See this issue.)

January 20th, and February 25th, 1921. The City Electric Light Co. 10,000-kw. turbo-alternator set; transformers and switchgear.

Melbourne.—February 24th, 1921. The Victorian Electricity Commissioners. Turbo-alternators of 25,000, 12,500 and 600 kw., and other plant connection with the Morwell power scheme.

New South Wales.—November 25th. P.M.G.'s Department. Telegraph and telephone instrument and switchboard parts (schedule 753).

South Australia. — October 20th. P.M.G.'s Department. Telegraph instruments (schedule 546), and telephone instruments (schedule 549). (September 10th.)

November 3rd. P.M.G.'s Department. Telephone instruments (schedule 548). (September 10th.)

November 11th. P.M.G.'s Department. Telephone instrument (schedule 547). (September 24th.)

Belgium.—October 15th. The Municipal Authorities of Fleurus are inviting tenders for certain additions to the electricity distributing service in the town. Particulars can be obtained from M. Goffin, Ingenieur-Conseil, 113, Avenue Albert, Brussels.

The Municipal Authorities of Tourinnez-Saint-Lambert (Province of Brabant), have just invited tenders for the concession for the supply of electricity in the town.

Birmingham.—October 11th. Salvage Department. Four electric vehicles for the removal of house refuse. (October 1st.)

Bradford.—October 28th. Electricity Department. Two natural-draught chimney-type cooling towers, pipework troughing, valves, &c. (Contract R 160). (September 24th.)

Indo-China.—January 3rd, 1921. Generating station at Gia-Lam; pumping station at Dong-Du on the Red River; electric line between above stations. Agence Générale des Colonies, Pièce 21, 2e étage, 27, Rue Oudinot, Paris.

India.—AGRA.—October 22nd. Municipal Board. Complete generating plant. (August 20th.)

London.—LONDON COUNTY COUNCIL.—October 25th. 125 tramcar bodies, 125 complete sets of maximum traction bogie trucks, and 125 electrical equipments, together with the assembling of same. (October 1st.)

LONDON INDIA OFFICE.—October 12th. Supply of hard drawn copper wire for telegraphs. Director General of Stores, India Office, Whitehall, S.W.1.

Manchester.—October 20th. Electricity Committee. Specification No. B.9. Five 8,500 K.V.A. 3-phase transformers and fans, &c.; and three 6,000 K.V.A. 3-phase transformers and fans, &c. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

October 27th. Electricity Committee. Complete heating installation for the workshop and stores at the Barton power station. Mr. S. L. Pearce, Chief Engineer and Manager, Dickinson Street.

October 27th. Electricity Committee. Three mechanical water screens, and three grid screens. (Specification B. 10.) (October 1st.)

Spain.—October 15th.—Tenders. Harbour Works Authorities at Alicante. Supply and erection of a 5-ton electric crane.

Sheffield.—October 12th. Electric Supply Department. Two 10,000-KW. steam turbines, condensing plants, pipework, &c., alternators and exciters. (September 10th.)

Uruguay.—December 18th. The Post Office authorities are, for the second time, inviting tenders for the construction of an underground telephone system here.

West Bromwich.—Corporation Electricity Department. Natural-draught cooling tower. (October 1st.)

West Hartlepool.—October 26th. Electricity Department. One 1000 KW. rotary converter and switchgear. (See this issue.)

CLOSED.

Australia.—The English Electric Co., of Australia, has received an order from the Railway Department for the supply of a 25,000-H.P. turbo-alternator to be used in connection with the electrification of the suburban railways. It is stated that this turbo-alternator will be the biggest unit of its kind constructed in Australia.—*Reuter's Trade Service.*

Derby.—Board of Guardians:—

Electric light installation, workhouse.—Messrs. Newton.

Dundalk.—Urban Council. Accepted:—

Erection of new water-cooling tower, £227.—Messrs. McAdorey.

Edinburgh.—Tenders for machinery for the new power station at Portobello were considered by the Corporation Electric Lighting Committee, who recommend that four of the six sections into which the work has been divided, should go to Messrs. Bruce, Peebles & Co. (involving an expenditure of over £80,000), and that the Metropolitan-Vickers Co. should have one of the remaining sections (£46,000), and the British Electric Co. the other (£7,000).

Exeter.—Electricity Committee. Accepted:—

1,500-kw. plant, £18,750.—Metropolitan-Vickers, Ltd.

Leeds.—Electricity Committee. Accepted:—

Extension of generating station, Whitehall Road.—Structural steelwork, Samuel Butler & Co., Ltd., £39,803; building work, William Airey and Son, Ltd., £162,970.

London.—STEPNEY.—Electricity Committee. Accepted:—

Coal supplies—
200 tons Bestwood main 2-in. nutty slack, 46s. 8d. per ton.—Shipping and Coal Co., Ltd.
100-150 tons Derby or Nottingham nutty slack, 47s. 6d. per ton.—Cleeves and Co.
150 tons Northumberland nutty small, 46s. per ton.—Wm. Cory & Son.
1,200 tons Ibstock double-screened peas, 39s. 11d. per ton; 3,000 tons do., 41s. 2d. per ton; 1,000 tons Arley double-screened nuts, 46s. 2d. per ton; 1,000 tons Ibstock double-screened nuts, 44s. per ton.—E. Foster and Co.

Cable—
2 miles 1 sq. in., ½ mile ·6 sq. in. and 1 mile ·007 sq. in. lead-covered cable.

W. T. Henley's Telegraph Works Co., Ltd. (accepted) ..	**£8,625**
British Insulated and Helsby Cables, Ltd.	8,720
Callender's Cable & Construction Co., Ltd.	6,984

Earthenware pipes—
1 mile 3-in. earthenware pipes, £369; ½ mile 3-in. do., £177.—Sutton & Co. (accepted).

Troughs and covers—
1 mile "C" troughs and covers.

Sutton & Co. (accepted)	**£327**
W. T. Henley's Telegraph Works Co., Ltd.	359
Siemens Bros. & Co., Ltd.	369

½ mile each "A and B," and 1 mile "C" troughs and covers:—

Sutton & Co. (Accepted)	**£567**
W. T. Henley's Telegraph Works Co., Ltd.,	£608

½ mile of "A," 1 mile "B," 1½ miles of "C" troughs and covers:—

Sutton & Co. (Accepted)	**£901**
Siemens Bros., & Co., Ltd.	£968
W. T. Henleys Telegraph Works Co., Ltd.	£989

½ mile 3-way 4-in. conduits, £544.—Albion Clay Co., Ltd.
½ ton tinmen's solder, £73.—G. W. Neale.—Accepted.
50 tons pitch, £110.—J. Smart & Son.—Accepted.
Shaping machine, £112.0.—Littons Machine Tool Co.
Aron meters, £163.—Aron Electricity Meter, Ltd.—Accepted.
Air compressor at Osborne Street sub-station £205.—Reavell & Co., Ltd.—Recommended.

Four-circuit breakers:—

Bertram Thomas (Recommended) ..	**£338**
I.T.E. Electric Co. (1907), Ltd.	£819

Replacing the existing intercommunication telephones:—

	20 lines.	30 lines.
Electrical Installations, Ltd. (recommended) ..	**£229**	**£557**
W. H. Gaze & Sons	—	442*
W. E. Weekes & Co.	—	453
J. W. Gray & Son	357	468
Higgins & Griffiths, Ltd.	485	598

*25-line instrument.

Meters and combined meters and demand indicators during the period ended June 30th, 1921:—

Meters—	2½-20 amp.	50-100 amp.	200-1,000 amp.	Combined meters and demand indicators. 200-1,000 amp. only.
	£	£	£	£
Aron Electricity Meter, Ltd.	—	—	508	**688**
Chamberlain & Hookham, Ltd.	1,378	451	327	—
Ferranti, Ltd.	1,378	**451**	327	—
Reason Manufacturing Co., Ltd.	**902**	369	329	—

The Committee recommends the acceptance of the tenders of Reason Manufacturing Co., Ltd., for 2½ to 20 amps. meters at £902; Ferranti, Ltd., for 50 and 100 amps. ditto, £451; and Aron Electricity Meters for 200 amps. and upwards combined meter and indicator, £688.

Manchester.—Electricity Committee. Accepted:—

ANNUAL CONTRACTS.

Meters.—Chamberlain & Hookham, Ltd.; Ferranti, Ltd.; Aron Electricity Meter, Ltd.; Metropolitan-Vickers Electrical Co., Ltd.
Current and potential transformers.—Ferranti, Ltd.
Time switches.—Venner Time Switches, Ltd.
Motor Starters.—Veritys, Ltd.; A. Reyrolle & Co., Ltd.; Compression Starter and Switchgear Co., Ltd.
A. C. Star-Delta switches.—Geo. Ellison.
Motors.—Veritys, Ltd.; English Electric Co., Ltd.; Metropolitan-Vickers Electrical Co., Ltd.; British Thomson-Houston Co.
75-ton crane and one 15-ton crane.—Babcock & Wilcox, Ltd. Sub Contractors:—Motors—Electric Construction Co., Ltd. Controllers and switchgear—Allen, West & Co., Ltd. Electric brake—G. Ellison. Wire rope—R. S. Newall & Son, Ltd.
Supply and laying of the Barton 33,000-volt trunk feeders, pilot cables and spare pipes.—Callender's Cable and Construction Co., Ltd. Subcontractors for pipes—Doulton & Co., Ltd.

Rivers Committee. Accepted:—

Motors and accessories for sludge drying plant.—Electric Construction Co., Ltd.

Tramways Committee, Accepted:—

Steel girder tramway rails.—Walter Scott, Ltd.
Special track work.—Titan Trackwork Co., Ltd.; Hadfields, Ltd., and E. Allen & Co., Ltd.

West Indies.—Orders for a 450 B.H.P. Vickers-Petter semi-Diesel crude oil engine and a 300 KW. Brush alternator, forming part of a complete installation for one of their clients in the West Indies, have been placed by Messrs. Chiswell & Co., of Kingsway.

Wimbledon.—Town Council.

Worthington-Simpson vertical Simplex pump, £426.—Spearing Roller Co., Ltd.

Electrical Corona.—When a sudden strain is thrown upon a transmission line by lightning or otherwise it has been noted that lines operating with very high voltage, and in consequence with a corona, suffer less damage than those at lower voltages. It was proposed in a paper read before the American Philosophical Society to have the voltage of the line not at, but a little below, the point necessary for the development of the corona. Then, when a sudden rise of electrical pressure occurs, the corona will form and will act as a sort of safety-valve by dissipating energy. A second use is for the measurement of crest values of high A.C. voltages. With round wires the corona appears at definite voltages, depending on the diameter of the wire and on the pressure and temperature of the air. An instrument has been devised by which applied potentials up to 400,000 volts can be measured from the known connection of the corona with the three variables. The corona is detected by its causing the air to become a conductor, thus enabling a current to flow through a galvanometer. In a confined space the corona is accompanied by a loud noise.—*Technical Review.*

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, October 8th. At 39, Victoria Street, S.W., at 8 p.m. Lecturette on "The Manufacture of Wood-Wool," by Mr. A. J. Simpson.

Friday, October 15th. Lecturette on "Elementary Physics and Chemistry in Relation to Motor-cars," by Mr. R. S. Fox.

Manchester Association of Engineers.—Saturday, October 9th. At 2.30 p.m. Visit to the Openshaw Works of Sir W. G. Armstrong, Whitworth and Co., Ltd. At 7 p.m., at the Memorial Hall, Albert Square. Inaugural Address by the President, Mr. H. Pilling, and Presentation of the Constantine and Butterworth Gold Medals.

Keighley Association of Engineers.—Saturday, October 9th. Lecture on "The Practical Application of the Thermo-electric Drive to the Naval and Mercantile Services," by Capt. W. P. Durtnall.

Birmingham and District Electric Club.—Saturday, October 9th. At the Grand Hotel, Colmore Row, at 7 p.m. Paper on "Thermo-electric Currents as applied to Pyrometry," by Mr. F. S. Pile and Mr. G. E. M. Stone.

Institution of Electrical Engineers (South Midland Centre, Students' Section).—Tuesday, October 12th. At the University, Edmund Street, at 7.30 p.m. Chairman's (Mr. E. T. G. Donovan) Address, and paper on "Hydro-electric Power Schemes," by Mr. E. Gallizia.

Association of Engineers-in-Charge.—Wednesday, October 13th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Progress in Industrial Lighting," by Mr. L. Gaster.

Chelmsford Engineering Society.—Wednesday, October 13th. At the East Anglian Institute of Agriculture, at 7 p.m. Presidential Address by Mr. T. E. Dann.

Royal Society of Arts (Indian Section).—Friday, October 15th. At John Street, Adelphi, W.C., at 4.30 p.m. Lecture on "British Trade with India, by Mr. T. Ainscough, H.M. Senior Trade Commissioner in India and Ceylon.

Commercial Vehicle Exhibition at Olympia, W.—October 15th to 23rd.

Electrical Power Engineers' Association.—Saturday, October 9th. At the Holborn Restaurant. At 5.30 p.m. Annual Dinner to the National Executive Council. Saturday, October 16th. At the Christian Institute, 74, Bothwell Street, Glasgow, at 7 p.m. General Meeting. Address by Mr. J. W. Thomas, assistant general secretary.

Electricity Supply Commercial Association (Greater London Division).—Monday, October 18th, at Caxton Hall, Westminster. Mass Meeting.

NOTES.

Electric Locomotives.—At a meeting of the York section of the Association of Engineering and Shipbuilding Draughtsmen on September 30th, a lecture on "Electric Locomotives," was read by Mr. R. H. Wright.

Big Motor Ships.—According to the *Motor Ship* for October, a 15,000-ton vessel is now on order for Italian shipowners, and a German-built vessel of the same tonnage has just completed her maiden voyage. The largest British motor ship—the *Glenogle*—of 14,000 tons, is illustrated, as well as those above mentioned. A motor ship has completed voyages totalling 200,000 miles without an involuntary stop.

While electric power is freely used on board these ships for handling cargo, &c., it is not being widely adopted for propulsion, in spite of the advantages it offers in conjunction with the oil engine.

Association of German Electrical Engineers.—Various electrical associations have just held their annual conferences at Hanover, including the Verband Deutscher Elektrotechniker. The report presented to the latter states that the number of members increased from 5,700 in 1919 to 6,341 this year, these being distributed over 22 associations affiliated with the Verband. The relations between the latter and the Association of German Engineers have been strengthened, and the two associations and the Association of German Metallurgists, established at the beginning of this year a technical journal, printed in the German, English, and Spanish languages.

Automatic Train Control.—The Ministry of Transport and officials of the Great Eastern Railway Co. recently carried out tests between Grange Hill and Fairlop, Essex, with the Regan Safety Devices Co.'s automatic train-control system, which consists of an electrically-operated brake on the locomotive operated by means of a ramp on the track.

Educational.—BIRMINGHAM UNIVERSITY.—The Senate has launched an appeal for half a million pounds. It is due to the enormous growth in the work of the University in applied science. The increase in students in electrical and mechanical engineering, in coalmining and petroleum, and in metallurgy, chemistry, and physics, has been phenomenal; and for physics and chemistry, 10 army huts, 70 ft. × 30 ft., have been erected as temporary laboratories. The curious fact, Sir Gilbert Barling, Bart., the Vice-Chancellor, states, is that the greater the growth in the number of students, the greater the loss to the University, as the fees are only sufficient to cover about a fourth of the cost involved. To increase the fees would mean that many students could not attend, so the appeal for money is made to the Government and to Midland manufacturers. The number of undergraduates in electrical engineering is about twice what it was before the war.

Under the combined auspices of the Bradford Education Committee and the Bradford Mechanics' Institute, Mr. G. Percy Bailey, M.A., on October 4th, commenced a series of six Oxford University Extension Lectures, at Bradford, on "Problems of Heating and Lighting." The lectures are illustrated by experiments.

The International Catalogue.—Last week the Government entertained at dinner the delegates to a conference convened by the Royal Society, to consider the position of the International Catalogue of Scientific Literature. The conference agreed as to the value of the catalogue, but difficulties had been experienced owing to the loss of the support formerly received from Germany, Austria, and Russia. A Committee was appointed to consider the position.

"Irish Leave."—In a report recently presented to the Dublin Corporation, the Electricity Supply Committee intimated that the secretary, Mr. Fred. Allan, had undergone a sentence of three months' imprisonment on a charge of having seditious literature in his possession, and that the Committee, finding that an accumulation of holidays covering more than the period of three months was due to Mr. Allan, granted him three months' leave of absence. The Law Agent reported that this decision was quite in order. Mr. Allan has resumed duty.

Electricity in Agriculture.—Active steps are being taken in France to popularise the use of electric agricultural machinery. A motor-culture week, organised by the Chambre Syndicate de Motor-culture de France, has just been held near Chartres from October 1st to 6th, in which some 50 French and foreign firms took part, demonstrations being carried out with over 150 machines and apparatus of various kinds. A similar demonstration will be held in the latter part of this month on the borders of the departments of the Eure-et-Loir and the Seine-et-Oise. An area of 380 hectares will be worked, a high-pressure line (15,000 volts), 6½ km. long, having been installed to provide energy for the operations.

Einstein's Theory.—It is reported that in a discussion which recently took place at Bad Nauheim, in connection with Einstein's theory of relativity, Prof. Grebe, of Bonn, stated that the third and remaining test of the truth of the theory had been complied with, measurements of the solar spectrum having revealed a shift towards the red which agreed closely with Einstein's predicted value.

A Chair of Hydro-Electrics.—Mr. T. D. Owen has given £10,000 to the University of North Wales, Bangor, for the foundation of a chair, in his name, of electrical engineering and hydro-electrics.

Electric Ship Propulsion.—On October 9th Captain W. P. Durtnall is to give a lecture before the Keighley Association of Engineers, on the Paragon system of ship propulsion, describing his latest design in the form of a 40,000-H.P. plant for the propulsion of a large liner or battleship, with high-power gas engines and electrical transmission of power for driving the propellers.

Iceberg Detector.—A device has been perfected which makes it possible, says the *Journal of Electricity*, to detect the presence of icebergs by measuring the amount of salt in currents of sea water. The vital part of the device is an electrolytic cell which measures the electrical resistance of ocean water by the aid of alternating current.

Fatality.—While John Harrison (28) electrical engineer, Paisley, was mounted on a ladder in the Glasgow Corporation electric power station, at Dalmarnock Road, examining an electric wire, supposed to be uncharged, he touched the wire, and receiving a shock, fell backwards. His head struck against the concrete floor and he was instantly killed.

The British Science Guild.—Owing to the disturbed state of public affairs, the British Science Guild has postponed until the spring the Guild dinner, which was to have been given at the Salter's Hall on October 26th.

Research Associations.—The Secretary of the Department of Scientific and Industrial Research announces that a licence has been issued by the Board of Trade to the British Electrical and Allied Industries Research Association, which has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of Industrial research. The Association may be approached through Mr. E. B. Wedmore, Electrical Research Committee, c/o Electrical Development Association, Hampden House, 64, Kingsway, W.C. 2.

In the report of the Department, which we reviewed last week, it is mentioned that membership of this research association will be open "not only to manufacturers of electrical machinery, but also to firms engaged in the production of the different machines which comprise the whole of the plant of an electrical power station except boilers. This association will be the first example of its kind. It is a combination of several distinct industries, each of which depends on the others."

On Thursday last week, the British Grey and Malleable Cast-Iron Research Association was formally brought into being in Birmingham. The Association's headquarters will be in that city, and the secretary is Mr. T. Vickers, Lincoln's Inn, Birmingham. The movement is of considerable interest to the great electrical engineering trades of Birmingham and the Midlands, in view of the immense output for them by the malleable iron trades. Sir Frank Heath, K.C.B., pointed out that it was claimed as a result of a Research Association in America that they could make malleable castings of 50 per cent. greater tensile strength than was possible in this country. If that were true, it was a serious matter. Competition was, however, really nearer, for he learned that in Scotland there was an Association of light castings manufacturers which had established a research laboratory. There was nothing corresponding to this south of the Tweed.

The Spot-Welding of Tubes.—The *Electrical News* of Toronto recently described a method of jointing tubes by means of spot welding. The chief difficulty is that the weld is accessible from the outside of the tube only. The problem then is so to direct the current through the metal that it effectively heats the point of contact, and so to adjust the pressure that it will be sufficient to ensure a good spot, but not so great that it will distort the shape of the tube.

Several experiments were performed at various pressures and with different currents flowing, and a special lower electrode designed so that there would be no burning of the metal in touch with it, had to be fitted to an improvised spot welding machine.

The steel tubes on which experiments were conducted had an external diameter of five-eighths of an inch, the thickness of metal being about 1/32 inch. They were formed in dies to special shapes, and the joints had been made by soldering, but the results were not satisfactory.

The part "A" (fig. 1) is joined to a straight piece of tubing, there being on "A" a flange which closely fits the latter and nearly surrounds it. Three spot welds were made on each side as shown. (Fig. 2, marked by arrows on end view.) In the first experiments the welds caused slight indentations in the surface of the part "A." Later when finer adjustments were made they became merely a roughness on the surface and, after the final dipping in a thick aluminium paint, were not noticeable at all.

The operation of welding is quite simple and rapidly done. The copper part "C," fig. 2, is the specially designed lower electrode, grooved at the top to allow the part "B" to fit in and make electrical contact over a comparatively large surface. The part "A" is mechanically fitted to part "B" in the exact location where it is desired to secure it, and the upper electrode brought into contact with this part. The current is turned on for a few seconds and then off again before the upper electrode is lifted. Only one spot is made at a time,

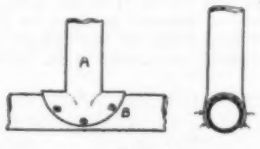
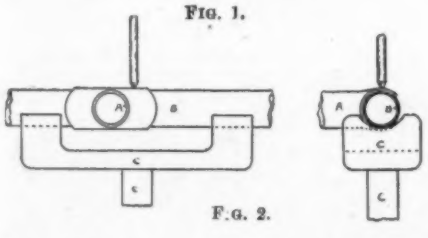


FIG. 1.



F.G. 2.

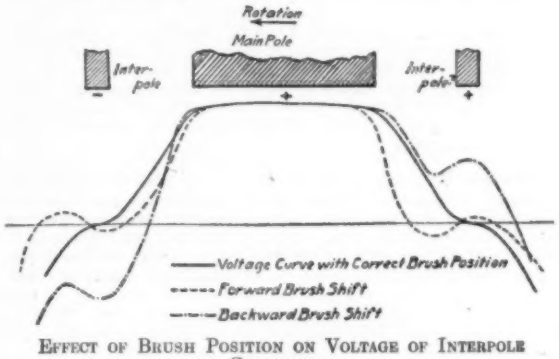
the complete joint requiring four or six spots according to the strength desired; six spots (three on each side) gave a joint stronger than the material itself.

It is questionable whether the soldered joint, even at best, has one-half the strength of such a welded joint. There is also in the soldered joint a certain tendency to break under shock, which is overcome in the welded joint.

In conclusion, the following facts may be mentioned: The current required is 2,300 amps., the pressure about 7 lb., and the time during which the current is allowed to flow is one second. While the process of spot welding produces results which are stronger than soldering or riveting, it also lessens the time required for the operation. In this particular case quantity production was the object, and approximately 60 per cent. of time was saved in this one operation.

Shifting Brushes on Interpole Generators. — Much sparking and change of voltage may be caused on an interpole generator with a very slight shift of the brushes from the correct neutral point. When the brushes are shifted the interpoles either assist the main series field in raising the voltage as load comes on, or buck the series field causing reduced voltage or too small an increase of voltage with the load.

If the brushes are given a forward shift, as is often done by operators accustomed to handling non-interpole machines, the coil which is sending current to the brush gets out from the influence of the interpole before it reaches the brush. In other words, the interpole acts on the coil when the coil is still in the field of the main pole just behind the interpole, which is of opposite polarity to the interpole. The net result is a reduction in the total flux and a consequent reduction of the generator voltage as the load increases. The remedy is to set the brushes at the correct position. It should be noted that the brushes may have been set so far ahead that they have reached a second neutral point, indicated in the accompanying diagram by the crossing of the zero line at the extreme left. In this case when an attempt is made to move the brushes back toward the correct position sparking may increase, but with the brushes moved still further back the sparking will again cease. A case of this kind recently occurred on a 300-KW., 250-volt machine in a steel plant. While cleaning the machine the operator had shifted the brushes to the non-sparking point just mentioned. The machine would not hold load properly, but when the operator attempted to shift the brushes back again the increased sparking alarmed him. However, after a troubleman had finally shifted the rocker ring back to the original mark the sparking stopped, and the machine held up its voltage properly on load. The false neutral point was 2 in. (5 cm.) on the rocker ring ahead of the correct position.



EFFECT OF BRUSH POSITION ON VOLTAGE OF INTERPOLE GENERATOR.

In case the brushes are given a backward shift, the interpole acts on the coil after it reaches the brush. As each interpole is of the same polarity as the main pole ahead of it, an extra amount of terminal voltage due to the interpole is added to the main field voltage, and the terminal voltage of the machine will consequently increase with load. A very small amount of such shift, even half a bar, may cause sparking. In the diagram the voltage of the coil when the brushes are shifted backward is shown by the chain-dotted line.—James Dixon in the *Electrical World*.

Penalising Low Power Factor.—The *Electrical News* of September 1st deals with a method adopted for encouraging the use of apparatus giving a high power-factor, and penalising customers whose P.F. is below a certain percentage; 0.85 is calculated to be about the average factor for general purposes, and for this the number of kilowatt-hours actually recorded is charged for. For power factors above or below this average the number of kilowatt-hours metered is multiplied by a constant according to a scale which is shown below.

Effective Monthly Power Factor	Constant	Effective Monthly Power Factor	Constant
1·00	0·951	0·70	1·0835
0·95	0·965	0·65	1·1255
0·90	0·981	0·60	1·1785
0·85	1·000	0·55	1·2455
0·80	1·023	0·50	1·3335
0·75	1·050		

Constants for other than the effective power-factors given in the table are determined from the same formula used to determine the given constants.

Thus for an average power factor of 85, which is taken as standard, the customer will be billed for the amount of energy consumed as shown by the kilowatt-hour meter. But when the power-factor is below or above 85 the metered kilowatt-hours are multiplied by the constant corresponding to the power-factor. For example, suppose that the true energy used during the month was 100,000 KW.-hours, and an average power-factor of 75 was maintained. Multiplying 100,000 KW.-hours by 1.05, the constant for 75 per cent. power-factor, gives 105,000 KW.-hours, for which the customer could be billed. Had an average power-factor of 95 been maintained, the constant 0.965 would have been used and the bill rendered for 96,500 KW.-hours.

Unfortunately the way in which the consumer's power factor is ascertained is not given in the article.

A New Projector Arc Lamp.—A new form of arc lamp in which a fixed annular water cooled metallic negative electrode surrounds the end of a coaxial horizontal positive electrode has been designed by M. Garbardini, says *L'Industrie Electrique*. The lamp is particularly intended for projector work, and has a fixed position of crater and a fixed arc length. A solenoid surrounding the electrodes creates a field which keeps the arc rotating rapidly round the tip of the carbon electrode. This only requires to be fed slowly forward. The negative electrode, being of cooled metal and having the arc continually moving over it, does not give out light so that only the tip of the carbon rod is incandescent. A further advantage is that the negative electrode does not obstruct any of the light. Neither constructive details nor particulars of the feed arrangements are given. The lamp is stated to have been tried in the French Navy.—*Technical Review*.

Appointments Vacant.—Charge engineer (£305) for the Swansea Corporation electricity department; 60 Morse telegraphists (275 Rs. per mensem), 2 Creed and Wheatstone mechanics (300 Rs. per mensem) for the Mesopotamia Civil Administration; lecturers in mechanical engineering and mechanical and electrical engineering for the Wigan and District Mining and Technical College; cable jointer for the Eccles Corporation electricity works; workshop instructor for the Electrical Wiring Class at the Hackney Institute; cable jointer for the South Shields electricity supply department; cable jointer for the Rawtenstall Corporation electricity department; shift engineer, £400 + 50 per cent., for the electric power plant at Dar-es-Salaam. See our advertisement pages to-day.

Birmingham Electrical Golfing Society. — The 12th meeting of this society will be held on the Streetly Links on Monday afternoon, October 11th. The Dr. Railing Cup is up for competition, with other prizes, and a record entry is anticipated. It has been decided that after this meeting, and for 1921, new members will be charged an entrance fee of 10s. 6d., in addition to the annual subscription.

Electric Vehicle Competition.—On September 25th the Liverpool Commercial Motor Users' Association held its first commercial motor parade, quite an interesting feature of which was the section for electrics. Messrs. Henry Tate & Sons, Ltd., won the first prize with an electric lorry (fig. 1), delivered just over 12 months ago, since when it has done 2,600 miles. It covers about 50 miles per week with average loads of 6 tons and 11 tons with trailer. Ironclad Exide accumulators are used. Messrs. J. Blake & Co., of Liverpool, won second prize with two Royal Mail vans (fig. 2).

Germany and Japan.—The German Minister at Tokio, Dr. Solf, made his first public utterance last week. In a long speech before the Economic Association, he declared that Germany and Japan must go hand in hand along the path of industry and commerce. After paying a flattering tribute to Japan's commercial expansion, Dr. Solf deprecated the alarm caused by the present economic depression, and said that the Germans were looking forward to receiving the assistance of Japan, in the hope that the ties severed by the war would be knit even closer than before. In conclusion, Dr. Solf said: "Japan cannot expect to export much to Germany, but the exchange of mental resources will counterbalance this."—*Reuter.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—The first meeting of the South Midland Students' Section will be held on October 12th, at the University, Birmingham. The chairman, Mr. E. T. G. Donovan, will open the meeting with an address, and Mr. M. E. Gallivin will read a paper on "Hydro-Electric Power Schemes," to be followed by a discussion.

Association of Mining Electrical Engineers.—The Yorkshire Branch of the Association held its first meeting of the session at Wakefield, on the 4th inst. Mr. J. W. Harbottle (Allerton-Bywater) was elected president for the coming year. A discussion took place on the new rules affecting electricity on the surface and in the mines. It was decided, however, to hold over the debate on the subject until the next meeting, which will be held at Wakefield on November 6th.

About 40 members of the Midland branch of the Association paid a visit, on September 25th, to the works of the D.P. Battery Co., Ltd., at Bakewell. In the absence of Mr. J. Waddell, manager of the company, the visitors were welcomed on arrival at the works by Mr. H. G. Brown, assistant manager, who conducted them through the various departments and explained the processes gone through in the manufacture of storage batteries for lighting, power, and vehicle work. The visitors were particularly interested in the type of cell designed for ship's wireless and also that for use in modern submarines.

Wireless Society of London.—At the general meeting held at the Institution of Civil Engineers on September 30th, 1920, the President announced that the following provincial wireless societies had been affiliated; this brings the total now affiliated up to 27:—The Stockport Wireless Society, Sussex Wireless Research Society, Wireless Society of Hull and District, Bradford Wireless Society, and Preston Wireless Society.

In view of the retirement of Captain W. J. Shaw, Mr. E. W. Kitchin, A.M.I.C.E., and Dr. F. C. Knight, M.D., from the committee, it has been arranged that Mr. Philip Coursey, B.Sc., Mr. J. Scott-Taggart, M.C., and Mr. G. G. Blake, A.M.I.E.E., fill their places until the annual general meeting in December, when definite elections will take place for the ensuing 12 months. In view of the ever-increasing amount of work falling to the hon.

Fig. 1.

Fig. 2.

Commercial Electric Vehicles at Liverpool.

Graphite in Belt Dressing Removes Static Electricity.—For eliminating static electricity from belting in works where very explosive vapours are present the safest method is probably to mix some graphite with the belt dressing. This makes the belt sufficiently conducting to prevent building up static voltage. An unsuccessful and probably dangerous method that has been tried in the past is to place wire points or pipes and other metallic objects in close proximity to the belt, connecting these objects with the ground in order that they may carry off the static electricity. Such a device, however, has been found ineffective because at times an accumulation of static electricity would pass in a spark from the belt to the device, thus defeating the purpose for which it was designed, as the spark is liable to set fire to explosive vapour. A fire was started in this way in a certain japanning factory, which afterwards adopted the method of mixing graphite with the belt dressing. The new method eliminated the trouble, but it was necessary to keep a check on the condition of the dressing to be sure that it did not wear off. This was accomplished by means of a gold-leaf electroscope held near the belt. The leaves of such an electroscope will diverge when in proximity to a belt holding static electricity. —C. M. Green in the *Electrical World.*

The Training of Ex-Service Men.—According to the *Sheffield Independent*, the Board of Education has informed some 40 or 50 ex-service men who are in training at Sheffield University, that their awards will be discontinued in consequence of unfavourable reports from the University as to their progress. Keen resentment has been aroused by this action, and the matter is to be taken up by the Northern Counties Universities Ex-Servicemen's Association.

secretary, Mr. L. McMichael, M.I.R.E., it has been arranged that Mr. A. W. Hambling becomes assistant hon. secretary. The meeting was the first of the new session, and upwards of 200 members were present to listen to the instructive paper on "the making and working of a resistance amplifier," which Mr. Maurice Child presented.

Twenty-five new members have been elected, and the society may congratulate itself on the inclusion among the new members of Mr. E. H. Shaughnessy, O.B.E., M.I.E.E., of the wireless section of the G.P.O. It is hoped during the present session to make arrangements for visits to certain electrical works.

Association of Engineering and Shipbuilding Draughtsmen.—The first of the new session's lectures of the York Branch was on "Electric Locomotives," by Mr. R. H. Wright. Mr. Wright described the characteristics of the various types of electric motors and their fitness for different classes of work. He showed the benefits of the general introduction of electric locomotives as against steam, and outlined features in the design of electric locomotives. In the discussion a good deal of consideration was given to the subject of the relative weights available at the driving wheels of steam and electric locomotives, the relative economy of working and maintenance, the inductive interference of high-tension overhead wires with telegraph and telephone wires, and the limitations likely to be imposed on the steam locomotives due to the standard loading gauge, &c.

Chelmsford Engineering Society.—The session opens on October 13th, when Mr. T. E. Dann will deliver his presidential address. A number of electrical papers will be presented during the session, including "Electric Traction," by Mr. E. H. Field, A.M.I.E.E., and "Electric Welding," by Mr. J. H. Johnson, M.I.E.E.

Institute of Metals.—The 1920-21 session commences on October 12th, when Mr. H. W. Brownsdon, M.Sc., Ph.D., will deliver the chairman's address. An attractive programme has been arranged for the session, including lectures by Lord Weir, Dr. W. Rosenhain, F.R.S., Prof. T. Turner, M.Sc., and a number of other well-known authorities.

The Telegraphone Resurrected.—The latest correspondence idea, says the *Journal of Electricity*, is the telegraphone which combines the principles of telephone, telegraph and phonograph, so that one talks into the machine and the message is recorded on disks of thin steel which have been given the name of "talking post-cards." These are sent through the mail and "played" on the telegraphone of the recipient, who may "erase" the post-card with a magnet and send it back with his return message.

Maximum Prices and Profits.—As we go to press, a correspondent writes as follows :—

The subject dealt with under this title in your leader columns of October 1st, is of great importance.

I do not think there is any doubt that the Electricity Commissioners realise the difficulties under which many small undertakings are working and are endeavouring to help in the most sympathetic manner.

One must not forget that behind the Commissioners stands the Government with all those views concerning the treatment of public utilities which have been only too obvious within recent years.

It is perhaps unnecessary to anticipate any conclusion which the Commissioners may have reached and not yet announced; however, there can be no harm, quite the contrary, in pressing the point in and out of season that if the public are to secure the benefits of electricity supply freely, quickly, and unhampered by restrictions, that result can only come about under conditions which allow the investing public to secure a reasonable return for their money and risk.

These arguments apply with particular force to the smaller areas operated by private companies. In many of these to-day the clamouring demand for electricity supply is being refused and discouraged, because the financial return secured by the operating company is totally insufficient to encourage the investment of fresh capital.

It seems almost tragic that whilst well-to-do people are asking for electricity supply and willing to pay good rates for it, many undertakings are unable to obtain capital for the construction of such permanent and remunerative works as underground distribution cables.

Although not so obvious, the same argument really applies to municipal undertakings; if these are to be run on a bare margin and without adequate reserve, there can never be that freedom and liberality in extending plant and distribution mains speculatively which is really the basis of a cheap and abundant supply of electricity.

For how many years have we not been obliged to adopt the policy of extending mains piecemeal, and to follow actual demands?

How many thousands of pounds might have been saved had it been possible to cable streets *as streets*, and without regard to the particular business offered at the moment?

You refer very properly to the comparatively high yield to be derived from Government securities, and mention that many industrials are offering safe investment at 8 per cent., but there are also trading firms of all kinds which are known to pay profits of at least double that amount, and this particularly applies to those which provide luxuries and the lesser essentials of life.

It is a guiding principle of business that success is bound up with the prosperity of the ultimate distributor. Anyone undertaking the risk of a great producing plant is careful to see that the last retailer has encouragement in the form of substantial profits to extend the demand and meet it in every possible way.

The final or retailing function is the most important one of the electricity supply undertaking, and one which has had the least attention.

In many small areas, whether the undertaking be public or private, it seems possible that retailing and distributing will become the chief function, and unless bulk supplies are handed out under such terms and conditions as will permit of a reasonable surplus, and encourage energetic local action, the extension of mains, advertising, loan and hire of appliances, and service work in its widest forms, the fact that those bulk supplies are handed out at a very low rate may not, and probably will not, by itself be sufficient to bring about rapid electrification amongst the community.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. W. A. Welden, station superintendent at the Rawtenstall electricity works, who has been appointed to a similar position at Stoke-on-Trent, was, on September 30th, presented with a gold albert by the employés and staff at Rawtenstall as an expression of the esteem in which he was held. The presentation was made by Mr. Stewart, borough electrical engineer. A large number of applications were received for the vacant position. Four candidates were interviewed by the Committee on Wednesday, September 29th, and Mr. S. H. Wilkes, of the Cleveland and Durham Electric Power Co., was appointed.

Dandalk Urban Council has increased the salary of its electrical engineer, Mr. P. A. Spalding, from £500 to £575 per annum.

Chesterfield Town Council has granted the following increases in salary :—Mr. Davies, station superintendent, from £300 to £432; Mr. Penker, mains superintendent, from £292 to £418; Mr. Gill shift engineer, from £228 to £322; Mr. Mott, shift engineer, from £213 to £299; Mr. G. Boden, shift engineer, from £193 to £271; Mr. A. P. Biggin, meter superintendent, from £251 to £360.

The financial Press reports that Sir Philip Lloyd-Greame, K.B.E., M.P., has retired from the Board of the Anglo-Argentine Tramways Co., Ltd., on accepting office as Parliamentary Secretary to the Board of Trade.

Mr. P. J. Pringle, general manager and chief engineer of the Electric Supply Co. of Victoria, who has been paying a visit to this country with his family, partly on holiday and partly in connection with the business of the company, is returning to Australia to-day per P. & O. s.s. *Mantua*.

Mr. P. Gordon Hieatt, of Derby, has been appointed shift charge engineer at Croydon.

Mr. Herbert Mason, for six years mechanical and electrical engineer to Taquah Mine and Abosso Mine of West Africa, has gone into partnership with Messrs. Hyde & Thomson, Ltd., electrical and mechanical engineers, Fitzalan Square, Sheffield.

Obituary.—Dr. Hugo Cassirer.—The death is announced from Berlin, at the early age of 51 years, of Dr. Hugo Cassirer, a leading authority on electric cable and wire manufacture. The deceased was born in Breslau, and started his career in the cable works of a relative in Vienna; later he came to England to complete his studies, and was, it is stated, for some time at the Johnson and Phillips' works at Charlton, about the year 1892. Later he returned to Berlin, where in 1896 he started the electric cable manufacturing firm of D. Cassirer & Co.

NEW COMPANIES REGISTERED.

Gilberts, Ltd. (170,394).—Private company. Registered September 23rd. Capital, £2,000 in £1 shares. Manufacturers of electrical fittings of all kinds, art metal work and metal furnishings, coppersmiths, &c. The first directors are: H. Davies, 15, Hillfield Park, Muswell Hill, N. 10; A. W. Green, High Beech, Pinner Road, Pinner; W. C. McMillan, 9, The Grange Drive, Winchmore Hill, N. Registered office: 15, Hillfield Park, Muswell Hill, N. 10.

Alan Evans, Ltd. (170,512).—Private company. Registered September 29th. Capital, £1,000 in £1 shares. To carry on the business of electrical and automobile and general engineers, manufacturers of and dealers in motor cars, &c. The first directors are: H. E. Watts, Southlea, Fairfield Park Road, Cheltenham; C. S. Watts, Brenta, Leckhampton Road, Cheltenham; A. V. Evans, 6, Priory Street, Cheltenham. Secretary: C. S. Watts. Registered office: Grafton Motor Works, Norwood Road, Cheltenham.

W. T. Rawcliffe, Ltd. (170,480).—Private company. Registered September 27th. Capital, £10,000 in £1 shares. To acquire and turn to account lands and buildings in the U.K., U.S.A., Canada, or elsewhere, and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power, or otherwise, &c. The subscribers (each with one share) are: W. T. Rawcliffe, 28, Osborne Road, Levenshulme, Manchester, electrical engineer; E. Jones, 3, Central Road, Blackpool, electrical engineer. The first directors are: T. S. Jones, 85, Reads Road, Blackpool; E. Jones, W. A. Mortimer, 110, Reads Road, Blackpool, and W. T. Rawcliffe. Registered office: 3, Greengate, Victoria Bridge, Salford.

Tillotsons, Ltd. (170,397).—Private company. Registered September 24th. Capital, £3,000 in £1 shares. To take over the business carried on at 52, Kennington Park Road, London, as "Tillotson Brothers," and to carry on the business of electrical, sanitary, and hot-water engineers, manufacturers of electrical and mechanical instruments of all kinds, &c. The first directors are: S. G. Tillotson, 52, Kennington Park Road, S.E.11; C. R. Turner, 59, Canning Road, Croydon; R. N. Flint, Mount View, Otford, Kent; H. Campbell, 102, Chewton Road, Walthamstow. The two first named are permanent. Secretary: S. G. Tillotson. Registered office: 52, Kennington Park Road, S.E. 11.

Dome Battery & Accessories, Ltd. (170,537).—Private company. Registered September 30th. £10,000 in 5,000 ordinary shares of 10s. each, and 7,500 preferred shares of £1 each. To take over the business of an automobile and die engineer carried on by W. J. Berry at 12, Hop Exchange, and 26, Southwark Street, S.E. The permanent directors are: S. B. Harcourt, 28-36, Salisbury House, E.C., managing director, Belgravia Properties, Ltd.; W. A. C. Dicketts, Poland House, Oxford Street, W. 1, director, Supreme Radiator Co., Ltd. Registered office: 12, Hop Exchange, Southwark Street, S.E.

Adapta Sign & Trading Co., Ltd. (170,452).—Private company. Registered September 27th. Capital, £15,000 in £1 shares. To carry on the business of manufacturers of electrical or mechanical devices or apparatus for advertisement purposes, &c., and to adopt an agreement with J. C. Wilson and D. Figur. The subscribers (each with one share) are: N. Figur, 31, Cossington Road, Westcliffe-on-Sea, clerk; E. Plunket, 48, Portsdown Road, W., electrical engineer; D. Figur, Leicester House, 5, Green Street, Leicester Square, W.C.2, solicitor; J. C. Wilson, 10, Park Valley, Nottingham, manufacturer. The first directors are: D. Figur (chairman) and J. C. Wilson (both permanent), and N. Figur. J. C. Wilson is managing director. Qualification £500. Registered office: Suite No. 1, Leicester House, 5, Green Street, Leicester Square, W.C. 2.

Nelson Engineering Co., Ltd. (170,500).—Private company. Registered September. Capital, £2,000 in £1 shares. To carry on the business of electrical and mechanical engineers, fitters, millwrights, founders, &c. The first directors are: C. H. Kay, 6, Railway Terrace, Brierfield; C. E. A. Young, 13, Market Square, Nelson; A. E. Adams, 115, Sackville Street, Brierfield; A. Roberts, Helmsdale Road, Nelson. Secretary: C. H. Kay. Registered office: 13, Market Square, Nelson.

Millo Co., Ltd. (170,411).—Private company. Registered September 24th. Capital, £500 in £1 shares. To carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The permanent governing directors are: C. Milton (managing director), 65, Cawdor Road, Fallowfield; F. Law, 67, Richmond Street, Accrington. Registered office: 78, Deansgate Arcade, Manchester.

Farndons Power & General Electrical Co., Ltd. (170,442).—Private company. Registered September 25th. Capital, £20,000 in £1 shares. To carry on the business indicated by the title, and to adopt an agreement with Farndons Electric, Ltd. The subscribers (each with one share) are: F. Farndon, 76, Carnarvon Road, Stratford, E. 15, electrical engineer; H. M. Watson, "Muirfield," Kilnacolm, Renfrewshire, physician and surgeon. The first directors are: F. Farndon (managing director), P. Farndon, H. M. Watson, H. King, and T. J. Penny. The first three are permanent. Qualification, £375. Secretary: F. G. Saw. Registered office: 92, Romford Road, Stratford, E. 15.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bullers, Ltd.—Trust deed dated September 15th, 1920, to secure £250,000 debentures, charged on certain properties in Norton-in-the-Moors, Hanley, Tipton, and Newcastle-under-Lyne. Trustees: British Foreign and Colonial Corporation, Ltd.

Chipperfield, Ltd.—Mortgage dated September 20th, 1920, to secure £448, charged on certain land and buildings in Lowestoft. Holder: W. J. Croft, 4, Thurston Road, Lowestoft.

J. G. White & Co., Ltd.—Return dated July 18th, 1920 (filed August 12th). Capital, £500,000 in £1 shares (180,000 preferred and 320,000 ordinary), 180,000 preferred and 200,000 ordinary shares taken up. £150,000 paid. £230,000 considered as paid. Mortgages and charges, Nil.

CITY NOTES.

Swiss Companies.

The general meeting of the *Société d'Exploitation des Cables Electriques of Lausanne* has decided to pay a dividend at the rate of 20 per cent.

The *Watt A.C. fur Elektrische Unternehmungen of Glarus*, which is closely associated with the Zurich Bank for Electrical Undertakings, reports a loss of 2,886,000 fr. for 1919-20, as compared with a loss of 2,970,000 fr. in the previous year. Among the investments the report mentions that the Vorarlberg power works of Andelsbuch paid a dividend of 5 per cent. for 1919, and the Allgau Electricity Co. a rate of 5 per cent. The further depreciation of the Austrian kroner reduced the receipts from the Austrian undertakings to such a level as to have rendered necessary the conclusion of a fresh arrangement with the holders of the company's debentures.

The report of *Escher, Wyss & Co., of Zurich*, states that a further increase in the turnover took place in 1919-20. The hydraulic turbine department was very busy, and large sets of the new type of steam turbine were delivered by the respective departments, while the compressor shops were also well occupied. After making provision for depreciation the net profits are returned at 804,000 fr., as against 688,000 fr. in 1918-19, and the dividend is at the rate of 6 per cent., as compared with 5 per cent. on the ordinary share capital of 6,500,000 fr. As it was desired not to be excluded from the Italian market owing to the fall in exchange, the company in conjunction with the firm of De Pretto, of Sehio, formed a limited company under the title of the Società Anonima de Pretto-Escher Wyss. The stock of orders at the end of the financial year was greater than at the beginning, and the reserve manifested by customers in the summer of 1919 had since been replaced by the allocation of orders to a satisfactory extent.

The Zurich Bank for Electrical Undertakings.

The shareholders in the Bank fur Elektrische Unternechmungen of Zurich, at the annual meeting held in that city on September 24th, adopted resolutions authorising the directors to enter into agreements with the creditors on the basis of the scheme of reorganisation recently detailed in this journal, and in this event to reduce the ordinary share capital from 75,000,000 fr. to 18,750,000 fr. Before the resolutions were put to the vote, Dr. Frey, chairman of the board of directors, is reported to have stated that the deficiency for 1919-20 amounted to 56,000,000 fr., that an intermediary balance struck on September 20th showed a further loss of 7,000,000 fr., and that the total losses in consequence of the exchange losses through the war exceeded 150,000,000 fr. As to the question of various objections raised against the business management of the bank, the chairman emphasised the fact that the bank was intended for the cultivation of international financial transactions from its inception. During the early period of the war the problem had been examined of dividing the bank into two parallel undertakings, one of which would have absorbed the German interests, and the other all the other investments, but the difficulties in the way were found to be insurmountable. The reproach that too much had been placed upon one card—the German—was only correct to a limited extent. The strong participation in German undertakings only dated from the time of the community of interests concluded in 1911 with the Lahmeyer Co., but this had been and still was at present one of the most advantageous transactions undertaken by the bank. As to the remunerativeness of the investments, the chairman stated that that of the German stood at the top with a yield of 7.27 per cent. In conclusion, he remarked that the individual who could say that he had regarded before the war the possibility of German currency depreciating to the extent which it had done down to the present could be the first to throw stones at the bank.

Cordoba Light Power and Traction Co., Ltd.

In his address at the annual meeting, Sir George A. Touche said that the importance of the San Roque lake was accentuated now that fuel prices had risen to such an alarming extent. From that lake they derived all their water for the hydraulic generation of electric current. They maintained a reserve steam-power station for use in case of emergency, when there was a severe drought. Although there was no drought during the year under review, they had been obliged to put their steam station into operation frequently, and the resulting loss would have been avoided had the regulation of the overflow of the water from the dam been arranged with more regard for the company's requirements. The first consideration of the Government must be for irrigation, but they believed that some system of releasing the water could be arranged which, without injury to the interests of irrigation, would coincide with the period when the demand for electricity in the city was at its maximum. The Provincial Legislature had under consideration measures for raising and strengthening the dam. The gross receipts of the company's combined businesses were £200,635, an increase of 18 per cent. over 1919, and of 26 per cent. over 1914. The improvement was being more than maintained in the current year. The tramways company's figures showed a considerable improvement over the previous year, in spite of the strike. They had acquired the only other tramway system in the city, and when they had electrified a portion of it, it should prove a useful addition to the system. As regarded the Light & Power Co., there was no dearth of new business offering, and the expansion of late had been remarkable, but extensions, which under pre-war conditions would have been satisfactory, were no longer attractive owing to increased cost. At present some consumers were actually paying less than the present cost of the service they received, and that could not be continued. The question of charges was engaging the attention of the board. They were not without hope that certain new arrangements might be made which would enable the company to offer an improved service of tramways to the city, including the electrification of a portion of the recently acquired horse tramway.

Victoria Falls and Transvaal Power Co., Ltd.

Presiding at the annual meeting, on Friday last, the Marquess of Winchester said he had to submit a satisfactory account of the company's business. Notwithstanding the ever-growing increase in cost in all classes of material, and in wages, &c., and in spite of the heavy taxation, the year's trading had enabled them to maintain the same dividends as last year, without reducing the carry forward to the current year. In reviewing the balance sheet, the chairman said that the leases and concessions of the various undertakings and the company's power stations, buildings, equipment, and land stood at lower figures than last year on account of the depreciation taken being more than the expenditure during the year. At the prices ruling to-day similar machinery could not be installed at anything like the prices at which the existing installations stood in the accounts. The revenue for the year amounted to £829,470, compared with £903,780 in the previous year. Sales of power, however, were practically the same, and the efficiency of generation and distribution was thoroughly maintained, but increased costs arising out of the present conditions and some provisions for contingencies on local account, resulted in the lower earnings. The amount paid for the service of debentures in the shape of interest and premium amounted to £219,160, being some £10,500 less than last year. Depreciation and amounts written off and provision for British taxation amounted to £394,488. The net result for the year was a profit of £175,626 after making provision for all taxation. Including the amount brought forward the total balance to the credit of the profit and loss account stood at £269,319. In respect of that balance the preference shareholders received three dividends, two each of 3 per cent. and one of 4 per cent., all less income tax, and the ordinary shareholders had received a dividend of 5 per cent., less income tax, in respect of the year 1919. Those dividends absorbed £174,999, leaving a balance remaining to the credit of the profit and loss account of £94,321, which had been carried forward to the current year. They were still without any settlement of the relief from British income tax in respect of Colonial taxation. Since the last meeting their claim was heard by the Special Commissioners of Income Tax, and was proved to their satisfaction on every point, and as far as they were aware there was now nothing to stand in the way of a settlement. An important matter to companies paying colonial taxes had recently been settled by the House of Lords on an appeal arising from a case heard in the Scotch courts. The effect of that ruling was that prior to the passing of the present Finance Act, preference shareholders in companies paying colonial tax were in the same position as preference shareholders in other undertakings, viz., they were all subject to the payment of full British income tax. With regard to the question of the renewal of their earlier contracts, the first to fall in had been renewed by the consumer for a further period of five years. In that connection they recently submitted a scheme for the consideration of the Transvaal Chamber of Mines for improving the conditions on which power was supplied in order to secure benefits to both consumer and supplier; while their proposal was appreciated as being advantageous from a power point of view, it was decided that the alterations to the hours of mining which the scheme involved introduced difficulties which outweighed from the consumer's standpoint the advantages afforded by the proposal. Referring to the position of the low-grade mines, the speaker hoped that when there was a cheapening of the price of commodities, and a reduction in the cost of living and production, it would still be a profitable enterprise to mine low-grade ore. A factor of a general character which, as regarded the sale of their power, had a steadying influence, was the fact that the supply of native labour was not un-

limited, and they found on taking a review over a long period that the sales of power varied with the number of natives employed. Generally speaking, natives displaced from low-grade mines could be absorbed by those with richer ore, and from their past experience the tendency was for the richer mines to also increase their demands for power with the increased labour supply offering, and thus offset the fall in demands resulting from the stoppage of low-grade mines. One could not lay down a definite rule or state to what dimensions that transference would be maintained, and whether the power which would result from the shut-down of large numbers of mines would all be absorbed, but up to the present their rate of supply had not fallen, in spite of large reductions of requirements by four of their consumers. During the current year the business had so far been satisfactorily maintained, and the amount of power sold was well up to that sold in the corresponding period of last year. Throughout the period under review an excellent service had been maintained, and the whole plant had worked satisfactorily and been well maintained, and the high efficiency of generation attained was a great testimonial to the ability of their operating and maintenance staff. No new extensions of any importance had been carried out, but an addition to their transmission system would shortly be undertaken, and would be paid for out of capital resources already available.

Mr. Arthur E. Hadley, C.B.E., seconded the motion.

The Chairman, in reply to questions, said that up to the present no development had taken place in regard to the harnessing of the Victoria Falls. It was a very large question to tackle, and unless there was a very considerable sale of power available in the immediate neighbourhood of the Falls, the project was not commercially advisable.

Replying to a shareholder who asked whether the Constantinesco wave transmission was likely to have any prejudicial effect upon the company, Mr. Hadley said he had seen the various installations that had been put up for water wave transmission, and he did not think it was in the least likely to affect the company in any way; unless possibly it might do so to its advantage. They were engaged on generation and transmission of very large amounts of power, while the water wave transmission plants were those purely for the local use of very small amounts, and when one came to deal with the bigger amounts, the size and strength of the pipes was a very great problem. The applications which he had seen for water wave transmission were those purely for the local use of power, and not for generation on a big scale.

The report was adopted.

Auckland Electric Tramways Co., Ltd.—The arrangements for the sale of the undertaking to the Corporation were completed during the year ended June, 1920. The amount payable by the Corporation was finally agreed at £1,227,201, payable as to £834,400 in debentures of the Corporation bearing interest at 5½ per cent., £392,800 in debentures bearing interest at 5 per cent., and £1 8s. 7d. in cash, the whole of the debentures carrying interest from July 1st, 1919, and being redeemable at par on July 1st, 1940. The revenue for the year was composed principally of interest upon the Corporation debentures, less interest paid on loans and advances, and amounting to £63,083. After providing for all expenses chargeable to Revenue, including £17,855 for debenture interest, there is a balance on revenue account of £36,958, making with £9,777 brought forward, £46,735. The dividend on the preference shares to June last requires £9,000, and the directors now recommend that a dividend be paid on the ordinary shares of 1s. 3d. per share, less income tax, which will require £28,125, and leave £9,610 to be carried forward.

Sir W. G. Armstrong Whitworth & Co., Ltd.—The directors report that for the four years ended December, 1919, the net profits, after making provision for taxation, depreciation, and the writing down of capital expenditure, amounted to £4,053,605. From this is deducted, says the *Financial Times*, £1,000,000 for further writing down of capital expenditure and £2,465,093 dividends paid for the four years, including the final distribution for 1919, leaving £588,512, which with the balance of £461,387 brought from 1915 gives a sum of £1,049,899 to be carried forward. The reorganisation of the works for peace industries is now complete, and much commercial work has been undertaken. But until the general conditions of manufacture become more stable it is difficult to make any forecast of the future.

Killorglin Electric Light & Power Co., Ltd.—At the fourth annual meeting a very successful year's working was reported. Increased consumption and advanced prices produced increased revenue. Coal now costs £5 per ton, as against 33s. 6d. pre-war. Dividend 8 per cent., free of income tax, declared, a substantial sum going to reserve.

Anglo-Argentine Tramways Co., Ltd.—The *Financial Times* reports that the board has decided to pay a further 12 months' arrears of dividend on the 5½ per cent. cumulative first preference shares.

Major & Co., Ltd.—An interim dividend of 3½ per cent. on the preferred ordinary shares is announced.

Rushden & District Electric Supply Co., Ltd.—Interim dividend of 5 per cent. per annum, less tax, for the half-year.

Southern Brazil Electric Co., Ltd.—At the meeting held last week Mr. E. H. Tootal said that the year's working had resulted in a profit of £1,500, compared with a loss of £7,000 for the preceding year. The improvement, though hardly equal to what was hoped for was, on the whole, satisfactory. Notwithstanding certain temporary adverse factors connected with Brazilian trade, their revenues had continued to increase in a gratifying manner since the date at which the last accounts were made up. The services of the various undertakings had been carried out without any hitch. They had been exempt from any strike troubles. The progress in the development of the undertakings was decidedly reassuring, and it only required a renewal of the former activity of the export trade of Brazil to make the progress more rapid and increasingly remunerative.

Cuba Submarine Telegraph Co., Ltd.—Interim dividend for the half-year ended June at the rate of 5 per cent. per annum, free of tax, on the ordinary shares.

The Danish Siemens-Schuckert Works.—The report of the Dansk A. S. Siemens-Schuckert states that the value of the turnover in the financial year ended on July 31st, 1920, amounted to 4,700,000 kronen. After providing for depreciation, taxes, &c., the net profits are returned at 169,000 kr., which have permitted of a payment of a dividend at the rate of 10 per cent. on the share capital of 900,000 kr. The orders brought into the new financial year represent 4,500,000 kr.

Lancashire Wire Co., Ltd.—This company, of Trafford Park, have redeemed their 6 per cent. debenture stock, the holders having exchanged their stock for ordinary shares at 10s. per share premium.

Bell Telephone Co.—This company has sold to a syndicate of bankers headed by Messrs. J. P. Morgan, $25,000,000 25-year 7 per cent. bonds at 95 per cent. dated from September 30th.—*Reuter.*

Dundee, Broughty Ferry & District Tramways Co.—Dividend at the rate of 5 per cent. per annum, less tax, on the ordinary shares. To reserve, £1,500; carried forward, £309.

STOCKS AND SHARES.

Tuesday Evening.

Conditions tend to repeat themselves in the Stock Exchange these days. With the coal strike still nominally in suspense, and other labour troubles hovering about in the near prospect, markets can hardly be expected to go ahead with any great verve. The Bank Rate also dangles its 8 per cent. apprehension over finance and commerce, but in spite of all its drawbacks, Stock Exchange business goes on steadily. The difficulties in trade circles are making their mark upon quotations. This week it is the motor share market that has suffered rather sharply owing to the advertised "cuts" in prices and to the closing down of a big works in America. Every day adds new testimony to the hard times that confront industry in the coming winter. But Stock Exchange philosophy says that we have seen much the same sort of thing before, and that the worst troubles which men have are those which never happen.

The Metropolitan District Railway is the first to be handed back to its own proprietors, apart from the Government control, and the company is now on its own feet in the matter of expenditure and assets. The price had been dull at 17½, and it promptly recovered to 18½. Underground incomes weakened to 66½, a drop of 1, and the shilling shares keep at 6s. 6d. Central London guaranteed ordinary stock is 2 higher at 43½ on the success of the new Ealing extension. The preferred stock is 45½, and the deferred 41.

In the foreign group, British Columbia preferred and deferred have come to the same level, with rises to 50½. Bombay Electric preference at 12½ are 15s. lower. The ordinary stock is quoted at the nominal price of 78-88; the last bargain marked in the stock is at 103 at the end of July. Brazilian Tractions are steady at 46s., and the preferred 81½, the latter attracting a fair degree of attention. British Electric Tractions remain tolerably firm at 31½, the preference at 61½; the 5 per cent debenture stock is now ex dividend at 65. A "special" bargain is marked this week in London United Tramways preference at 2s. 6d., and London Suburban preference have been done as high as 3s. 9d. The Mexican issues are still beneath the cloud of uncertainty as to what really is happening under the rule of the new President Obregon. People are beginning to complain that he does not seem to be getting on with things as quickly as hope had expected.

The Commercial Cable Company has again approached some of the holders of comparatively small amounts of its 4 per cent. debenture stock, offering 80 per cent. Therefore the price, which fell 12 points last month when the previous offer of the same price was withdrawn, has been put up again to 79. Two consecutive bargains were marked on October 1, one at 69 and the next at 79½. Proprietors who have the chance of selling to the company at 80 should certainly accept the bid, even at the risk of a higher price being offered later, which appears improbable unless the American exchange should move further against this country.

Marconis continue to improve, and at 2¾ again show 1/16 rise. The preference hardened to 2 11/16. Cable stocks as a whole are firm, with Eastern Extensions up to 15. There seems to be a certain amount of Eastern Telegraph stock in the market on behalf of deceased accounts, but it is being steadily absorbed in the neighbourhood of 148. Westerns are 14¼ ex dividend. Cuban Telephone 5 per cent. bonds at 85 are 4 points lower. In the manufacturing group, Callenders stiffened to 1¾, and the preference to 18s. 9d.

Other manufacturing shares, however, are inclined to be dull. British Aluminiums have drooped a little to 1 1/32, and Edisons to about the same price. In fact, both of them might be obtainable at £1. British Insulated at 33s. 9d. are ex dividend. The steady buying of industrials to which the London share market has been accustomed from Birmingham has given place to a disposition to sell, and this is also noticeable from Sheffield and from centres farther north. The result is that the ordinary buyer in the South, knowing pretty well whence sales are coming, is inclined to hold his hand, and the demand for industrials of all kinds is comparatively meagre. This applies also to the armament companies. The Armstrong company issued its report the other day, the first for several years, and, although the figures are considered good as a whole, they produced a certain amount of disappointment, and the shares eased off to 24s., while Vickers remain in the neighbourhood of 22s. 6d. The rubber share market, after a brief spasm of firmness, again reacted as the price of the produce fell to just under 1s. 6d. per lb. From this it is inferred that the steps that are being taken by the Rubber Growers' Association in the direction of curtailment of output may take some little time to become effective. Meanwhile, the supply of rubber outstrips the demand, and the fear remains present that there will be a considerable surplus of rubber at the end of this year.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Oct. 5, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	8½	—	£9 12 0
Charing Cross Ordinary	4	7	8½	—	10 15 6
do. do. do 4½ Pref.	4½	4½	2½	—	8 8 8
Chelsea	8	4	2½	—	7 12 5
City of London	8	10	1½	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7½	—	10 17 6
do. do. 6 per cent. Pref.	6	6	8½	—	7 7 8
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	1½	—	6 8 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	9½	—	10 18 2
do. 4½ per cent. Pref.	4½	4½	3½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	9 1 2
South London	5	6	9 xd	—	10 1 8
South Metropolitan Pref.	7	7	17/-	—	8 4 8
Westminster Ordinary	9	10	5	—	10 0 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	7½	—	7 14 10
do. Def.	33/6	1½	17½	—	8 18 10
Chile Telephone	8	6	5½	—	*5 9 1
Cuba Sub. Ord.	7	7	7½xd	+ ¼	*9 6 8
Eastern Extension	6	10	15	—	*6 13 4
Eastern Tel. Ord.	8	10	14½	—	*6 14 4
Globe Tel. and T. Ord.	8	10	14½	—	*6 18 0
do. do. Pref.	6	6	8xd	— ¼	7 10 0
Great Northern Tel.	22	25	20	—	11 0 0
Indo-European	15	10	80	—	6 6 8
Marconi	25	25	2¾	+ 1/16	8 18 10
Oriental Telephone Ord.	10	12	2¾	— 1/16	*4 18 4
United R. Plate Tel.	8	8	6½	—	*6 8 0
West India and Panama	1/8	Nil	½	—	Nil
Western Telegraph	8	10	14¾xd	—	*8 16 4
Home Rails.					
Central London Ord. Assented	4	4	43½	+2	9 4 0
Metropolitan	1	1½	21½	—	5 16 3
do. District	Nil	Nil	12½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	2½	—	Nil
do. do. "A"	Nil	Nil	6 6	—	Nil
do. do. Income	5	4	66½	— 1	—
Foreign Trams, &c.					
Anglo-Arg. Trams First Pref.	Nil	5½	8½	—	8 9 3
do. do. 2nd Pref.	Nil	Nil	3½	—	Nil
do. do. 5 Deb.	5	5	87½	+3	8 18 10
Brazil Tractions	Nil	Nil	46	—	Nil
Bombay Electric Pref.	6	6	12½	— ½	4 16 0
British Columbia Elec. Ry. Pfds.	5	5	54	+1½	9 5 2
do. do. Preferred	5½	5	60½	+2	*6 7 3
do. do. Deferred	Nil	3	50½	+3½	*6 7 3
do. do. Deb.	4½	4½	58½	—	7 19 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	4½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	8½	—	Nil
Mexican Light Common	Nil	Nil	14	—	Nil
do. Pref.	Nil	Nil	27½	—1	Nil
do. 1st Bonds	Nil	Nil	86	—2	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	9½	—	*5 0 0
British Aluminium Ord.	10	10	1 1/32	—	9 14 2
British Insulated Ord.	12½	15	1½xd	—	8 17 10
Callenders	25	15	1¾	+ 1/16	10 18 2
" 6½ Pref.	6½	6½	18/9	+9d.	6 18 8
Castner-Kellner	20	17	8	—	5 18 4
Crompton Ord.	10	10	17/6	—	11 8 6
Edison-Swan, "A"	10	10	23/6	—6d.	9 15 2
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	10	19/3	—	10 19 2
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 5
do. Ord.	10	10	28/-	—	*7 2 10
Hoadley	25	15	1¾	—	9 4 8
do. 4½ Pref.	4½	4½	5½	—	7 4 0
India-Rubber	10	10	1½	—	*8 0 0
Mat.-Vickers Pref.	—	6	3½	—	7 6 2
Siemens Ord.	15	10	25/-	—	*8 6 0
Telegraph Con.	20	20	20	—	*5 0 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, October 5th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/5	...
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	"	£92	...
a Bisulphide of Carbon	"	...	...
a Borax	"	£41	...
a Copper Sulphate	"	£43	...
a Potash, Chlorate	per lb.	1/-	...
a " Perchlorate	"	1/6	...
a Shellac	per cwt.	£92 10s.	...
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	"	£35	...
a " Lump	"	£22	...
a Soda, Chlorate	per lb.	6d.	...
a " Crystals	per ton	£13	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
p Babbitt's Metal Ingots	per ton	£95 to £800	...
c Brass (rolled metal 9" to 12" basis)	per lb.	1/3½	...
c " Tubes (solid drawn)	"	1/6 to 1/6½	½d. dec.
c " Wire, basis	"	1/4½	...
c Copper Tubes (solid drawn)	"	1/9	½d. dec.
c " Bars (best selected)	per ton	£164	£4 dec.
c " Sheet	"	£164	£4 dec.
c " Rod	"	£164	£4 dec.
d " (Electrolytic) Bars	"	£114	£4 dec.
d " " Sheets	"	£128	...
d " " Wire Rods	"	£130	£4 dec.
d " " H.C. Wire	per lb.	1/4½	½d. dec.
f Ebonite Rod	"	2/6	...
f " Sheet	"	2/-	...
n German Silver Wire	"	2/-	...
h Gutta-percha, fine	"	14/-	...
h India-rubber, Para fine	"	1/6	2d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l " Wire, galv. No. 8, P.O. qual.	"	£60	...
g Lead, English Pig	"	£36	20s. dec.
g Mercury	per bot.	£18 to £18 5s.	5s. to 10s. dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e " " " medium	"	5/- to 10/-	...
e " " " large	"	12/6 to 25/- & up	...
p Phosphor Bronze, plain castings	"	1/6 to 1/11	...
p " " rolled bars and rods	"	2/5 to 2/8	2d. to 3d. inc.
p " " rolled strip & sheet	"	2/5 to 2/9	...
d Silicium Bronze Wire	per lb.	2/-	...
r Steel, Magnet, in bars	"	1/8	...
n Tin, Block (English)	per ton	£267 to £268	30s. to 40s. dec.
n " Wire, Nos. 1 to 16	per lb.	4/9	...
p White Anti-friction Metals	per ton	£78 to £800	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
p ———
r W. F. Dennis & Co.

Electric Vehicles in the U.S.A.—A summary is given in the *Electrical World* of six papers presented to the Electric Vehicle Section of the N.E.L.A. at its recent Convention at Pasadena, U.S.A. Further development of electric vehicle business is said to depend upon more active co-operation by central stations, the establishment of adequate garage facilities, and the keeping of accurate cost records. A 60-car garage is considered to be the minimum on which to establish a profitable business. Even then it is difficult to make the garage pay by the supply of energy unless supplemented by the sale of accessories, &c. From 15 to 18 miles per day is the average delivery mileage where horses are used. The average speed of a 2-ton electric truck is 14 to 15 M.P.H. Rural or interurban deliveries of long mileage can be dealt with only by the petrol or steam vehicle. Electric vehicles are often abused in two ways, viz., by attempting to perform long mileage at high speed, and by constant neglect of the battery. It was shown that the cost per ton-mile for petrol vehicles rose from 5.3 cents in 1915 to 6.75 cents in 1919, whilst the corresponding cost for electric vehicles decreased consistently from 4.74 cents per ton-mile in 1915 to 4.17 cents in 1919. During the same period the average capacity per vehicle increased from 3 to 3.27 tons in the case of petrol vehicles and from 1.6 to 2.7 tons in the case of electric vehicles. The above costs include all expenses except interest, depreciation, insurance, and drivers' wages. From a large mass of operating cost figures it appears that the cost of operating the electric vehicle, taking all factors into consideration, is about half the cost of petrol transport for similar operating conditions. One of the speakers emphasised the fact that electric vehicles should be used for all work within their capacity because they are more economical than petrol vehicles, and the latter should be used only for work beyond the capacity of electric trucks. Complete accurate operating-cost records from large users show that a 5-ton petrol vehicle, operating about 40 miles per day, costs from $5 to $10 per day more than a 5-ton electric vehicle doing the same work.—*Technical Review.*

AUSTRALIA: A CRITICAL MARKET.

Competition to be met.

According to H.M. Trade Commissioner in Australia, the position regarding United States and Japanese competition in the Australian Commonwealth has not altered greatly during the past 12 months. The state of the dollar exchange has naturally had an adverse influence on American imports.

The large increase in American trade has brought a number of American firms, new to Australia, and inexperienced in overseas trade generally, into close contact with Australian firms. The latter in many cases have been dissatisfied with American methods, and the bulk of the trade should revert to the United Kingdom.

On the other hand, it is understood that various American organisations are making strenuous efforts to promote greater efficiency in export methods. It appears probable that in the future American competition will be felt more particularly in machinery, small tools, hardware, metals, motor cars, and specialities of various kinds. It will be noted that the foregoing are particularly the lines of trade in which British manufacturers are urged to improve their commercial organisation.

The Japanese methods of trade and quality of goods supplied have continued to be unsatisfactory.

As will have been noted from our leading columns recently, Japan is making great national efforts to improve her methods of manufacture and trading, and it is difficult to forecast the result of these efforts combined with the factor of cheap labour, though, as we have indicated, finality has not been reached in regard to labour, wages, and conditions. It appears probable that Japan will lose the bulk of her trade with Australia, which was created during the war.

In view of the circumstance that most of the raw materials necessary for manufacture exist in Australia, it is rather the competition arising from this factor that will have to be reckoned with by British exporters.

Manufacturing Developments.

The progress made in the Commonwealth in working up its copper production (which totalled £4,500,000 in value in 1918) is of interest to electrical manufacturers, particularly those who have established or contemplate the establishment of branch factories there. Works are established within the Commonwealth for the refining of copper as follows: At Port Kembla, N.S.W., owned by the Electrolytic Refining and Smelting Co. of Australia, Ltd., with a capacity for an output of 44,000 tons of electrolytic and fire-refined copper per annum. At Wallaroo, S.A. (Wallaroo and Moonta Mining & Smelting Co., Ltd.), with a capacity for an output of 9,000 tons of refined copper per annum. At Bowen, Q. (Mount Elliott, Ltd.), with a capacity for an output of 9,000 tons of refined copper per annum. At Lithgow, N.S.W. (Mouramba Mines, Ltd.), with a capacity for an output of 2,500 tons of refined copper per annum. At Kandos, N.S.W., works are being erected for the C.S.A. Mines, which, when completed, will have a capacity for an output of 2,500 tons of electrolytic copper per annum.

Metal Manufacturers, Ltd., are now manufacturing at Port Kembla, N.S.W., high conductivity copper wire, rods, bars, and strips. All the usual sections of bar and strip are being made as well as special sections including commutator segments. Hard and soft-drawn copper wire, and square, hexagonal, and round rods are produced in all sizes. Square and rectanglar wire of the dimensions of circular wire is made to order. Stranding machinery has been installed by the company to make hard-drawn bare copper strand of all known sizes. Single and double cotton-covered wires form a regular part of the output. The extension of the works to cover a wider field of production is now under consideration.

With regard to wolfram and molybdenite, the arrangement whereby during the war the Imperial Government acquired the Australian output, has now terminated.

Extensive deposits of iron ore and coal are widely distributed throughout Australia, but so far only two steel works have been established, viz., the Eshbank Iron Works, Lithgow, N.S.W., and the Broken Hill Proprietary Co., Ltd., at Newcastle, N.S.W. The Queensland Government has decided to proceed with the erection of a State steel works at Bowen, at a cost of about £3,000,000.

The Lithgow works were established in 1907. In 1917 the output was 45,025 tons of pig iron and 19,667 tons of steel ingots.

The Broken Hill Proprietary Co., Ltd., is utilising the immense deposit of iron ore at the Iron Knob quarries in South Australia, which are connected with the seaboard at Hummock Hill, a distance of about 36 miles, by the company's tramway. Extensive limestone works and loading bin at Devonport, Tasmania, as well as quarries in New South Wales for dolomite, magnesite, &c., are also owned by the company.

The number of men employed at the steel works, Newcastle, is 4,135. The capital expended on plant at Newcastle, Iron Knob, and other quarries, &c., to December 31st last, amounted to £4,390,054.

A number of subsidiary industries have either been established or are projected at Newcastle in connection with the steel works, including the manufacture of railway tires, axles, and other products of a capacity, as regards tires and axles, stated to be sufficient to meet the whole requirements of the Australian railways; the production of wire for fencing and general purposes; the manufacture of galvanised iron and black steel sheets; a tinplate works with a capacity of about 30,000 tons per year; pipe and tube works; the manufacture of wire netting; a plate rolling mill for the production of ship-building and other plates.

Some progress has been made towards the formation of an Australian Engineering Standards Association. Delay has occurred pending the formation of the Institution of Engineers of Australia, which was formally inaugurated in Sydney in October, 1919. It is felt that the Institution, which is representative of engineers throughout Australia, is the proper body to undertake or be closely identified with the formation of the Australian Engineering Standards Association.

Our readers will for the greater part be familiar with the Australian Association of British Manufacturers and their representatives. This Association, formed in 1910, has during the year usefully dealt with a number of important matters affecting the interests of British manufacturers and their representatives in Australia. The membership has now increased to 761, consisting of 295 representatives in Australia and 466 manufacturers in the United Kingdom. British manufacturers may be recommended to join this Association.

Import Statistics.

The total imports of machinery and other manufactures of metal in 1918-19 were £17,000,000 in value, compared with £9,698,970 in the previous year, and £15,416,548 in 1914-15.

The 1918-19 imports according to country of origin were:—

	£	Per cent.
United Kingdom	6,325,224	37.3
United States	8,509,002	50.1
Japan	524,280	3.0
Other countries	1,637,038	9.6
Total	£16,995,544	100.0

Items of interest in the above class, together with countries of origin, are shown in the following table:—

Articles.	United Kingdom. £	United States. £	Japan. £	All countries. £
Chain blocks and Travelling blocks	4,922	42,914	15	58,976
Engines, gas and oil ...	24,608	106,003	—	141,202
Dynamo electric machines	182,381	307,762	570	500,671
Rock drills	5,152	46,463	—	51,615
Machine tools	179,471	115,577	23	300,376
Brass plate and sheet ...	4,639	1,508	11,629	17,776
Copper plate and sheet ...	30,765	102,506	1,076	135,819
Electrical fittings and appliances	95,113	239,716	69,717	536,908
Iron and steel plate and sheets:				
Corrugated galvanised	154,816	654,250	—	809,418
Not corrugated do. ...	136,353	350,130	—	488,863
Plain not galvanised ...	174,461	439,503	—	618,970
Pipes and tubes, wrought	385,994	256,849	—	795,710
Telephones, &c.	9,411	69,596	—	80,864
Tinned plates and sheets	2,108,754	20,999	—	2,129,753
Tools of trade, not being machines	291,082	488,505	5,962	804,392

Hydro-electric Development.—Compared with other countries, Australia offers little prospect of hydro-electric development. In Victoria and New South Wales various schemes are proposed.

In Tasmania the Hydro-electric Department of the Tasmanian Government continued general extensions and survey work, reference to which has been made in these columns from time to time. It may be recorded that the present capacity of the plant is 18,000 H.P., and that during the year 1918-19, 32,134,388 units were sold. It is proposed shortly to increase the horse power to about 60,000 to 70,000 H.P. The current year's estimates include £558,000 for extensions. This amount forms the first instalment of an extension scheme involving a total capital expenditure of £2,500,000, but some years will elapse before this is accomplished. Machinery is already on order to bring the total up to 54,000 H.P., and it is anticipated that two more 8,000-H.P. units will have to be ordered at an early date. When these latter are installed, the capacity of the power station will amount to 70,000 H.P., which will be sufficient to provide for the following requirements: 30,000 H.P. for the electrolytic zinc works at Risdon, 10,000 H.P. for the carbide works at Electrona, 6,000 H.P. for Hobart, and 3,000 H.P. for Launceston, leaving a substantial margin for use as required. Tenders are at the present time being considered for the supply of material and erection of another double-circuit transmission line from the Waddamana power station to Hobart, while a line is also to be erected for delivering power to Launceston.

Mr. Butters, the engineer to the Department, is starting on a tour of inspection of installations and works in North America and Europe. He will be in England in October, when it is hoped British manufacturers will be able to impress him with the desirability of placing his orders in this country.

The scheme for the development of the brown coal deposits of Victoria has also been dealt with in some detail. The Commissioners recommend that the Victorian State should expend £3,000,000 on the generation of electricity from Morwell brown coal, and that the scheme should be put in hand at once. It is proposed that the power house should have an initial capacity of 50,000 KW. Borings have proved the existence of about 150,000,000 tons of brown coal within a radius of a mile of the proposed power house at Morwell.

The estimates include: Opening up Morwell Field, £221,000; electrical plant and system, £2,516,000; accommodation for workers, £150,000; briquetting plant, £30,000; total, £2,917,000.

The estimated bulk selling price of electric current in the metropolitan area of Melbourne is .434d. per unit.

The Adelaide Electric Supply Co., Ltd., has commenced the erection of a new power house on which it contemplates spending about £250,000. The station will take some years to complete.

The extension which has marked the co-operative movement amongst Australian farmers may not appear at first sight to be of much interest to the electrical trade. Yet it is of importance by reason of the fact that it is leading to the centralisation of the purchase of all agricultural supplies, which include a very large number of small petrol or paraffin-driven electric power sets for farm use. There is a big demand for such sets, and any British firms which succeed in placing them on the market at prices comparable with American quotations will reap a profitable harvest.

THE ELECTRIFICATION OF BRITISH RAILWAYS.

LAST week the Electrification of Railways Advisory Committee, appointed by the Minister of Transport to inquire into railway electrification, issued an important interim report, of which an abstract is given below. The committee was constituted as follows:—

Sir Alexander Kennedy (chairman); Sir John A. F. Aspinall, consulting mechanical engineer, Ministry of Transport; Mr. A. R. Cooper, engineer, Metropolitan District Railway and Tube Railways; Sir Philip Dawson; Sir Alexander Gibb, Director-General of Civil Engineering, M. of T.; Mr. Charles H. Merz; Sir Philip Nash, Director-General of Traffic, M. of T.; Mr. Lightly Simpson, chief mechanical engineer, M. of T.; Mr. Roger T. Smith, electrical engineer, Great Western Railway; Sir John Snell, Chairman of the Electricity Commission; Sir Henry Thornton, general manager and consulting engineer, Great Eastern Railway, representing the railway companies. Mr. S. G. Redman, secretary.

The report was adopted unanimously.

INTERIM REPORT.

The committee has held 28 sittings, and has had before it witnesses representing British railways, as well as Mr. Ivan Ofverholm, chief electrical engineer to the Swedish State Railways, and Col. Huber-Stockar, consulting engineer to the Federal State Railways of Switzerland. On the side of electrical contractors it has also had as witnesses representatives of the British Thomson-Houston Co., the English Electric Co., and the Metropolitan-Vickers Co., and a written communication from the Oerlikon Co.

The committee sent out in April, to all the chief railway companies, a questionnaire relating to the matters covered by the terms of reference, and from the replies to this, together with those sent in to the questionnaire issued in January by the Ministry, and the information given by the witnesses, full statistical tables have been prepared and have been considered in detail.

It is very desirable that decisions on certain general points should be arrived at as soon as possible; the committee has, therefore, confined consideration, in the first instance, to points of this nature, and deals only with them in this interim report. Further matters are left over for a subsequent report.

The terms of reference under which the committee was appointed are as follows:—

1. Whether any regulations should be made for the purpose of ensuring that the future electrification of railways in this country is carried out to the best advantage in regard to interchange of electric locomotives and rolling stock, uniformity of equipment, and/or other matters.

2. If any such regulations are desirable, what matters should be dealt with, and what regulations should be made.

3. How far it is desirable, if at all, that railways or sections of railways already electrified should be altered so that they may form parts of a unified system.

In respect of reference 1, the committee considers it desirable that certain general regulations should be made for observance by the railway companies when electrifying their lines. These regulations should be directed specially to ensuring standardisation of those methods and appliances which are likely to prove the most satisfactory, but such regulations should put no avoidable difficulties in the way of the adoption in future of improvements in methods or appliances.

In respect of reference 2, in view of the desirability of the railways which are now contemplating immediate electrification knowing as soon as possible the decision of the Minister on certain fundamental matters, the committee recommends that regulations should be issued in accordance with the following conditions:—

(i) That in the case of those railways which have not as yet electrified any lines, as well as those which at present have electrified all or part of their lines on a direct-current system, their electrification, or extended electrification as the case may be, should be carried out on the direct-current system.

(ii) That the standard pressure of the direct-current system at the sub-station busbars shall be 1,500 volts, subject to (*a*) The continuance of any existing 600 volt and/or 1,200 volt installations; (*b*) the adoption of half the standard voltage —750 volts—in those cases where advantage would arise from the use of this lower pressure; and (*c*) the adoption of higher pressures—limited to a multiple of the standard pressure—where sufficient advantage would accrue.

(iii) That both overhead and rail conductor collection should be permitted, as long as the position and general design of the conductors and structures are in accordance with recommendations which will be made in a subsequent report. In that report the committee will also suggest the regulations required to ensure that locomotives and/or motor coaches shall be able, wherever it may be necessary, to run at two different voltages, *e.g.*, 600/750 and 1,500 v., and/or with either rail or overhead collection.

(iv) That the generation of current for direct-current lines should be alternating 3-phase, at such voltage as may be desirable in each case.

(v) That in the case of existing generating stations supplying at any frequency between 25 and 50 cycles it is unnecessary to make any change in frequency, but where any one such frequency is in general use in a particular electricity district, any new power station put down in that district for supplying a railway should adopt the frequency which has been approved by the Electricity Commissioners or is in general use in that district.

Alternating current supplied to the sub-stations at a frequency of 50 cycles can be used for railway purposes without any detriment to railway working.

In respect of reference 3, the committee recommends:—

(i) That the electrical system of working in use on the Brighton Co.'s suburban lines need not be changed.

(ii) That in view of the recent proposals of the Government as to grouping of railway companies, the question of the system on which the L.B. & S. Coast Railway Co.'s proposed extensions to the coast should be carried out is now—in the event of the Government's proposals being approved by Parliament—one for special consideration from the point of view of the requirements of through working and interchangeability of traffic with the other systems forming part of the proposed southern group. Subject to these matters receiving the fullest consideration, and provided the completion of the proposed extension on the present system shows a substantial financial advantage, the committee is of opinion that it should be allowed.

The report can be obtained from H.M. Stationery Office, Imperial House, Kingsway, W.C. 2, price 3d. net.

I.E.E. Benevolent Fund.—The report of the Committee of Management and the statement of accounts for the year 1919 were unanimously adopted at the twenty-second annual general meeting that was held on May 20th last at the Institution of Civil Engineers, Mr. R. T. Smith, president of the I.E.E., presiding. Messrs. Sidney Sharp and J. Attfield, F.C.A., were re-elected hon. auditors, and the Committee of Management for 1920-21 was appointed as follows: Representing the Council: The President (*ex-officio*), Sir J. Devonshire, K.B.E., Col. H. C. Sparks, Messrs. J. Sayers, D. N. Dunlop, H. W. Clothier, H. J. Cash. Representing the contributors: Sir W. Slingo, Messrs. J. H. Rider, W. B. Esson, and the chairman of each Territorial Centre in the United Kingdom. The capital account stood on December 31st last at £5,709, all of which is invested; the income was £805, and the accumulated income amounted to £1,750, of which £1,726 has been invested. Among the larger donations received were two of £26 5s. from Messrs. Babcock & Wilcox, Ltd., and the "Twenty-five" Club respectively, and one of £25 from Messrs. W. T. Henley's Telegraph Works Co., Ltd. During 1919 25 applications for assistance were received, and the committee made grants in 24 cases as follows: One of £30, three of £25, seven of £10, six of £9 15s., one of £9, three of £8 15s., and three of £7 10s., a total of £291 5s. for the year.

The capital account of the Wilde Benevolent Fund stood on December 31st last at £2,587, the whole of which is invested, and brings in an annual income of £90. The balance standing to the credit of the income account on the same date was £7; no grant was made from this fund during the year.

THE MUNICIPAL TRAMWAYS ASSOCIATION

(INCORPORATED.)—IV.

Repairs and Depreciation in Relation to Capital and Revenue.

By James Dalrymple (General Manager of Glasgow Corporation Tramways).

(*Abstract.*)

During the past few months I have had ample opportunity for studying the financial position of a large number of tramway undertakings which are owned and operated by both companies and municipalities. I have invariably found that, where the financial position is shaky, the cars and other plant are generally very much worn and the track very rocky. The reason for this state of affairs, we must assume, is, that those tramway authorities have not the necessary funds to keep their undertakings in a proper state of repair, and we find that there are no funds in the renewal and depreciation account.

Many municipal authorities to-day seem quite prepared to give the very highest wages to their employés, but at the same time, entirely overlook the fact that their capital, as represented by the track and equipment, is rapidly going out of existence, and that the time is fast approaching when there will be no track and no equipment capable of earning revenue either for paying wages or for anything else.

In operating a tramway undertaking, whatever happens, the capital must be maintained, and this can only be done by keeping the concern in as complete a state of repair from day to day as possible, and, in addition, setting aside from year to year whatever amount of depreciation has taken place during the previous 12 months.

I have recently been going carefully into the physical and financial condition of many tramway undertakings. The position generally is that the revenue has not been sufficient to meet the increased wages granted to the staff, and, at the same time, enable the undertaking to spend what was required on repairs, and it generally follows, when you have too little spent in repairs, that you have nothing available to meet depreciation and renewal.

Many tramway undertakings throughout the country are in a good state of repair, and have considerable renewal funds; I find, however, some undertakings in which renewals are being added to capital. I find others where too little is being placed to the renewal and depreciation funds, in order that a sum may be available for the relief of the rates. I find some other undertakings where the plant and equipment are being starved to obviate the necessity for an increase in rates. I find other undertakings where the renewal fund has been actually depleted in order to relieve the rates.

In all the instances above referred to, the tramway capital is being tampered with in order to meet the current administrative expenses of the municipality.

The two largest items under the heading repairs and maintenance are, of course, track and rolling stock. The renewal of the track, which on a congested system occurs very frequently, is giving many of us much concern. Hitherto we have been reckoning on an average cost of about £4,000 per mile of single track, whereas the actual renewal is coming out at nearer £10,000. This increased cost has to be met in some way, and I would put in a very strong plea for the maintenance of our capital; this can only be done by keeping our system in thorough repair, and by setting aside ample funds to meet renewals.

A number of municipal tramway systems are, and have always been, in a hopeless position financially, and will likely remain a charge on the rates, but I think it is generally agreed that the tramway passenger should pay for his ride. The revenue from fares should, therefore, be sufficient not only to meet all running expenses and keep the plant in good working order, but also to meet all charges for interest and sinking fund, and to provide a fund to maintain the undertaking.

Repairs and Depreciation in Relation to Capital and Revenue.

By R. L. Horsfield (General Manager, Cardiff Corporation Tramways.)

(*Abstract.*)

A sinking fund is established for the purpose of redeeming debt within the period of time prescribed by the sanctioning authority, and by its means we may say that municipal property is obtained. It may well be named the "Property acquisition fund."

A depreciation fund is established for the purpose of restoring property, and may be called the "Property restoration fund."

Now, so far as tramways are concerned, if the last-named fund is abolished, we must be prepared to acquiesce in perpetual indebtedness, for it is obvious that we should not have an undertaking debt-free at any time. The distinction between these funds, therefore, is not one in name only, it is one of principle.

Provision for debt-redemption only, within the assumed useful life of the asset, is not prudently sufficient. There is a gradual wasting of the asset due to wear and tear, which cannot be met by current repairs charged to revenue annually, and it has been the experience of most tramway authorities that, for certain portions of the plant, and in particular permanent way, the loan period has not, in the past, been fixed well within the actual life of the asset. Let it be clearly understood that a sinking fund is not also a depreciation fund. It is therefore not only desirable, but of the utmost importance, that proper provision should be made to meet future necessities, as well as contingencies.

It should stand definitely and continually related to the revenue account. The declaration of so much "*profit*" without any provision for renewals is somewhat misleading. For wasting assets, that cannot be restored yearly, some provision should be made in the net revenue account, and no balance surplus should be treated as "*profit*" until that has been done.

Alternatively, and by way of a minimum requirement, provision should be made annually, and accumulated, for obsolescence.

No prudent undertaking should absorb annually every available £, without paying due regard to the demand which future years will almost certainly bring with them. The hand-to-mouth policy is fraught with possible grave consequences. Therefore I put in a plea for sound finance, and the constant strengthening of our resources.

It is not equitable that next year's passengers should be called upon to pay part of the fare of to-day's passengers, to the extent of the diminished value of the asset for which no provision is made this year.

Present-day conditions serve to emphasise, most strongly, the wisdom of those authorities who have in the past, prudently made provision for renewals, and it is clear that with the altered values as we find them to-day, the provision which was thought to be necessary in pre-war days, must be considerably augmented to-day. The County Borough of Walsall, with which the writer was until recently connected, accumulated a renewals fund which, in 1918, had reached its statutory limit. In 1919, in view of the increase in costs of material and labour which apparently are to remain more or less permanent, I advised it to seek authority to increase the maximum, and the local Legislation Committee granted a clause making the maximum two-fifths instead of one-fifth. When I took up my duties in Cardiff, I was pleased to observe that the Tramways Committee had accumulated funds for this purpose to the extent of £182,690.

It may be interesting to observe here that the Orders under the Act of 1920 for Increased Fares require that "The Corporation shall make reasonable provision for the proper repair and *renewal* of the undertaking."

With some authorities a tendency is springing up to borrow for renewals, which has the undesirable effect of keeping the maximum of debt alive. This tendency should, in my opinion, be discouraged.

To the extent to which we abandon prudent methods of financing tramway undertakings, to that extent shall we inflict injury upon the stability and strength of the credit of local authorities, which has been achieved through years of communal thrift, and cultivated zealously by those who have preceded us.

Discussion on the Foregoing Papers.

Ald. Fenton (Sheffield) said that in Sheffield it was held that those who found the credit should have some return for it. He protested against the injustice of requiring tramways to repair the paving which was so severely worn by the heavy motor traffic—but not by the tramcars. The charges for the maintenance of track should be put on the right shoulders.

Ald. Pailin (Bradford) said that where the track had outlasted the life of the loan, there was no reason why they should not borrow for renewal. A claim should be made on the Road Board for a fair share of the funds derived from taxation to make good the damage done to the roadbeds by heavy traffic.

Mr. H. P. Stokes (Plymouth) said that when the Tramway Committee at Plymouth, which maintained practically the whole roadway, put motor 'buses in operation, it was called upon by the Highways Committee to pay 1½d. a 'bus mile. A protest should be lodged before the new motor transport legislation was carried out. When an undertaking had paid off a loan, it was entitled to raise new capital—otherwise the present-day ratepayers would pay for the future, which was unfair.

Mr. W. Murray (Walthamstow) also asked why the present generation should provide a debt-free system for the next. Many items, such as land and buildings, bridges, and street widenings, would remain as good as ever for long years to come, and would in themselves constitute a fine legacy to our successors, even if the permanent way and rolling-stock

should perish. Cars that had been running 15 years in Walthamstow had been rebuilt, and were better than before.

Mr. J. M. McElroy (Manchester) said Parliament had laid it down that out of revenue they must pay expenses, interest, and sinking fund, after which they "may" provide a renewals fund. To provide for renewals out of revenue would in future be a very grave problem; they would have to reborrow to make good wasting assets.

Mr. C. Furness (Blackpool) said he had to renew the whole track at a cost of £280,000. Three-quarters of the debt had been redeemed, and they would reborrow to that extent. Tramway managers were generally agreed on this subject, but unfortunately committees were persuaded to hand over a surplus to the rates. The word "profit" should not be used; they ought to set aside for renewals before showing any profit, even if it involved a deficit.

Clr. West (Walthamstow) suggested that for the purpose of renewals the repayment of capital should be deferred for a few years.

Mr. J. B. Hamilton (Leeds) said the whole financial basis of municipal work depended upon the repayment of loans in stated periods. Thanks to their honourable observance of this rule, municipalities were able to borrow more cheaply than even the Government. They should be relieved of all unfair impediments to the provision of cheap transport.

Mr. Horsfield, in reply, said the essence of the papers was a plea for sound finance.

Mr. Beckett, replying for Mr. Dalrymple, remarked that their ancestors had done a great deal for them, and they should carry on the good work for the benefit of their successors.

The Future of Capital Expenditure.

By R. Stuart Pilcher (General Manager, Edinburgh Corporation Tramways.)

(*Abstract.*)

The cost of some commodities required for the operation of a tramway system is only 100 per cent. up, but the costs of materials for the construction of permanent way and new cars is considerably higher. The pre-war cost of permanent way construction may be put at £12,000 per mile of double track; at the present time the cost is in the neighbourhood of £40,000 per mile of double track, this being over 230 per cent. increase. With regard to rolling stock, in pre-war days single-truck top-covered cars with the latest electrical and mechanical equipment could be obtained for £900 each. To-day these cars will cost approximately £2,800, or over 200 per cent. increase. I have recently had to provide top covers for the Edinburgh cable cars, which are at present costing £550 each. These could have been obtained in 1914 for £120 each, and there appears to be no immediate prospect of the costs coming down for this class of work. The same abnormal increase applies to the construction of new buildings and to the provision of new plant, so that in this respect capital expenditure on new equipment or on new lines is very severely handicapped.

Capital expenditure requires new money, and money at present is only obtained at a high rate of interest. Pre-war money could be obtained at 3 per cent.; now, even with the best security, such as the large municipalities can give, 6 per cent. is required.

The present price of the 1929-47 5 per cent. Government loan stands at £85 per cent. At that price it will yield a dividend of £5 19s. per cent. per annum, and if the redemption is added, £6 5s. It is not clear that even now the peak price of money has been reached.

In considering this question we are therefore faced with the fact that new works require approximately 250 per cent. more capital for the same work, and that the rate of interest required is 100 per cent. up.

The question of new capital expenditure would solve itself if the revenue could be made to increase in the same ratio as the working expenses.

Most of the transport undertakings have been slow in raising the fares. The process of increasing the cost of travel must necessarily be slow and gradual, otherwise passengers will cease to ride or will ride less frequently. If the fares are raised gradually it will not be felt so much by the public; and the decrease in passengers carried—which is so noticeable all over the country—will be but a temporary state.

It is an extraordinary phase of the present public attitude that persons will willingly pay 100 to 200 per cent. for most commodities, but will not pay 100 per cent. increase on the car fares. In the course of time, I believe, the public will get over this, and will realise that the distance which can now be given for transport is only half what could be given in pre-war days. When this state is reached the financial position of the tramways will improve and the outlook for tramway capital expenditure will be more encouraging.

There is a great field for the motor 'bus, which can deal with extensions and new routes without any relatively great capital expenditure. In the case of unprofitable tramway routes, when the question of the renewal of the permanent way has to be considered, many such routes will be worked by motor 'buses or other railless vehicles.

In considering the question of the form of traction to be adopted in Edinburgh, the problem is not substantially different from those of electric undertakings which have in the near future to face extensive renewals of their permanent way. If electrification is carried out, the cost will be £695,700, compared with £1,677,600, for a new system. The cost of a new system would work out at 4.547d. per mile as against 2.672d. per 'bus mile for a similar number of 'buses costing £456,640—the mileage being the same in each case—viz., 5,759,520. In these figures similar amounts are provided for plant and buildings. The 'bus has a considerable advantage in capital expenditure over the figures for a complete new electric system, even providing for the same total seating capacity (£729,900). On the other hand, the working expenses of the 'bus are higher than those of the electric car.

When suburban routes are considered, or routes which have not a heavy traffic, the cost of capital expenditure for electric cars becomes prohibitive. It is in these circumstances that the motor 'bus will become the cheaper vehicle to operate. The total cost of capital expenditure depends upon the frequency of the 'bus service. The 'bus may be made to pay where the service is infrequent, the only condition being that the vehicle will require to be fairly well filled with passengers.

Future extensions and new routes will probably take the form of motor 'buses, or other vehicles not dependent on a costly permanent way. New transport will be provided and faster vehicles will be used and development will be quick. The 'bus should be used where the tramway cannot be used, and the one vehicle made supplementary to the other; I do not think that they need be competitive.

In Edinburgh the intention is to run all the extensions with 'buses, and instead of spending new capital on a tramway where the traffic is not sufficiently heavy to pay the high capital charges, motor 'buses are to be run. Only the future can tell at what point it will pay to lay tramway rails.

Discussion.

Mr. J. M. McElroy (Manchester), referring to the author's comparative figures, pointed out that while the capital cost of the 'buses was lower for the same number of vehicles, the working costs would be doubled owing to the greater number of 'buses required.

Ald. Pailin (Bradford) said they must be cautious in incurring capital expenditure. No outlay should be permitted which did not help the tramways to be productive—not for road-widening, &c.

Mr. R. H. Wilkinson (Bradford) said the working expenses of the 'bus were higher than those of the tramcar, and the latter were higher than those of the railless car; why, then, should they prefer motor 'buses to railless trolley cars? A railless car to carry 50 people was about to be put on the road; it was being built in Birmingham for him.

Mr. E. S. Rayner (Hull) said the comparative figures were misleading unless accompanied by the number of car-miles run per mile of track. With regard to motor 'buses, the most unsatisfactory feature was the varying price of fuel. A 50 per cent. increase in cost of coal had less effect on the working costs of electric traction than a 50 per cent. increase in cost of petrol. He agreed with Mr. Wilkinson as to the advantages of the railless car.

Mr. C. Furness (Blackpool) criticised the comparative figures, and suggested that the loan period for the tramcar was at least double that for the 'bus.

Mr. J. B. Hamilton (Leeds) pointed out that Mr. Pilcher's figures explicitly related only to capital costs. If a larger railless vehicle could be got, it would have a very good chance in competition with the 'bus and tramcar, and would serve the purpose of extensions of the tramways. They should think about using open construction in the country; it would be possible to give rail transport in many cases at 30 per cent. of the cost of a street tramway, together with a speed of 20 m.p.h., against 8 or 10, and lower maintenance costs. Speed was the pressing need of the day, to reduce the time of transit; if a journey took over 12 or 15 minutes, a workman could not travel more than twice a day.

In reply, Mr. Pilcher said that on some routes in Edinburgh cars could not possibly be run, but 'buses were being run on them successfully. Railless traction was not extending as had been expected ten years ago; the use of fixed wires deprived it of mobility, which was an asset of the motor 'bus. There was hardly an electric tramway system in the country where the 'bus would not prove useful. It was interesting to note that when the Edinburgh Council talked of stopping the tramcars on some routes, the Highways Committee at once wanted to know who was going to maintain the roadways. The loan periods were for the tramways 30 years, for the 'buses eight years. In future, a longer period would have to elapse before rails could be laid along a new route.

Electrical Treatment for Tooth Diseases.—In the ordinary treatment of pyorrhœa, one of the commonest diseases of the teeth, antiseptics are taken into the mouth, but they only reach the surface of the gums. A new treatment for the disease was recently demonstrated to a *Daily Mail* representative by Mr. W. Howell, a medical electrician of London, which consists in the use of a powerful antiseptic which is forced deep into the gums by an electric current, thus reaching the microbes more easily and destroying them more effectually.

THE QUEENSTON-CHIPPAWA DEVELOPMENT.

In the September issue of the *Journal of the Engineering Institute of Canada*, a number of engineers in the service of the Hydro-electric Commission of Ontario presented papers bearing upon various aspects of the work being carried out by the Commission at Queenston. During the war the needs of factories engaged upon the production of munitions and other war *matériel* became so great that an acute power shortage was felt. As there seemed every prospect of the conflict lasting for at least four or five years, in 1917 the Commission decided to commence this immense undertaking, estimating that by 1921 200,000 H.P. would be available from this source. Fortunately the war concluded before the undertaking was completed, but the enormously increased peace demands made the completion of the work essential. Although the first part of the undertaking will consist of units having a total of 250,000 H.P., everything is being planned with a view to an ultimate capacity of 500,000 H.P. The main point for consideration in choosing the site of this development was the utilisation of as much of the 327 ft. difference in level between Lakes Erie and Ontario as was consistent with general economic working. Several schemes had previously been formulated, the most practicable of which was the Jordan-Erie scheme, which necessitated the cutting of a canal 24 miles

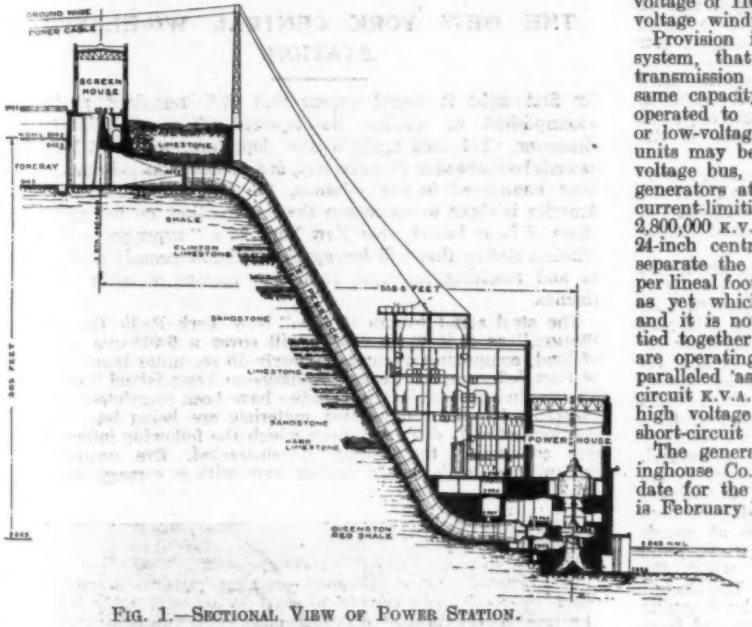


FIG. 1.—SECTIONAL VIEW OF POWER STATION.

long, and which also involved a number of other features open to serious objection. In the present project the intake is at the mouth of the Welland river above Niagara Falls. From this point the improved channel of the Welland river is utilised for a distance of 4½ miles, and a canal 8½ miles in length then conveys the water to the power house at Queenston on the Niagara river. In this way a total head of 305 ft. is obtained, as shown in fig. 1, which is a section through the screen house, penstocks, and power house. The initial plant is to consist of five turbines, each of 50,000 H.P. rated capacity. These will be of the vertical, spiral case, single runner Francis type, operating at a speed of 187½ R.P.M. The guaranteed maximum efficiency is 90 per cent., but it is probable, in view of recent experience, that this figure will be exceeded. The inlet diameter of the scroll case is 10 ft., and the diameter of the runner at the inlet 10 ft. 5 in. An open space has been left in the power house foundations below the runner so that by removing a section of the draft tube the runner can be taken out from below, thus obviating the necessity of dismantling the generator when it is required to renew the runner. The runner is designed for a capacity of 61,000 H.P., and is "gated back" to a maximum capacity of 55,000 H.P. The reason for this is that the turbines, which will normally operate at or near full rated load, will operate, therefore, at their maximum efficiency also. Special taps have been provided in the crown plate, and from the annular spaces round the discharge side of the runner, to which gauges can be attached to keep a record of the varying pressures at these several points. This will furnish an indication of the wearing away of the runner seal and show when renewals of seal rings are necessary. Connections from these chambers to the scroll case and draft tube will allow readjustment of the downward thrust when required. The runners and spiral casings are of cast steel tested at a pressure of 260 lb. per sq. in.

Mr. Edgar T. J. Brandon, A.M.E.I.C., contributed the following information to the *Journal* regarding the electrical equipment of the station:—

A novel feature of the generating room is that the main floor is level with the top of the generator frame. Space between this floor and the floor at the bottom of the generator is utilised for cooling air, power leads, and piping. The generating room is approximately 60 ft. wide by 60 ft. high, the units being spaced at 50 ft. centres. The space devoted to transformers and low and high voltage switching is approximately 90 ft. wide by 100 ft. high, the equipment belonging to each generating unit occupying a length corresponding to the 50 ft. taken by the generator.

The electrical plant consists of 45,000 K.V.A., 12,000 volt, 25 cycle, 187½ R.P.M., vertical shaft generators with thrust bearings and direct-connected exciters. The thrust bearings to be used are designed to carry a load of about one million pounds. Five such units have already been contracted for. About 100,000 cubic feet of air per minute will be required to cool the generators at full load. The air system is completely enclosed so that the cooling medium can be taken from and discharged to the outside air without mixing with the air inside the station. It is interesting to note that the weight of air passing through the generator every three hours equals the complete weight of the generator itself.

In the present installation there will be fifteen 15,000 K.V.A., 25 cycle, single-phase transformers which will be used for transforming from the generator voltage of 12,000 to a nominal voltage of 110,000. Taps are, however, provided in the high-voltage windings to permit operation at 132,000 volts.

Provision is being made for operation on the "unit" system, that is, the generator, bank of transformers and transmission line will be considered as a unit, and have the same capacity, so that in case of emergency a unit may be operated to full capacity without utilising either the high or low-voltage busbars. Provision will also be made so that units may be operated in parallel on either the high or low voltage bus, current-limiting reactors being provided between generators at 12,000 volts. With 8 units paralleled without current-limiting reactors it would be possible to obtain about 2,800,000 K.V.A. in a fault. Such a condition with busbars at 24-inch centres would impose mechanical forces tending to separate the bars of the order of one and one-quarter tons per lineal foot. However, oil switches have not been developed as yet which will rupture such large amounts of energy, and it is not intended that the units shall be operated all tied together without reactors. The two limits of operation are operating the units entirely separated and with 8 units paralleled as above. The former imposes a possible short circuit K.V.A. of probably 360,000 and 230,000 on the low and high voltage circuits respectively, while the corresponding short-circuit K.V.A. for the latter are 2,800,000 and 1,800,000.

The generators are being supplied by the Canadian Westinghouse Co., Ltd., of Hamilton, Ontario, and the contract date for the completion of the first unit ready for operation is February 1st, 1921.

ELECTRIC STEELS.

By C. G. CARLISLE.

(*Abstract of paper read before the Autumn Meeting of the* IRON AND STEEL INSTITUTE *at Cardiff.*)

The electric furnace owes its popularity largely to the war and to the ease with which it dealt with immense quantities of turnings, rather than to any real conversion on the part of steel manufacturers (with some notable exceptions) in their opinion as to its merits. Electric furnacemen became very serious contributors to the output of steel of the best quality for war purposes.

The history of steel-making during the last thirty years could be written in terms of a struggle to keep sulphur and phosphorus down. The electric basic-lined furnace has made it possible to obtain steel containing 0.02 per cent. sulphur, and sometimes, as in the case of some of the alloy steels, 0.01 per cent. Practically no information is available as to the composition of electric furnace slags and the accompanying metal, from the point of view of the sulphur and phosphorus contained. The author gives particulars of samples taken and analysed by himself.

Size of furnace evidently has an important effect on the elimination of sulphur. This is due mainly to the fact that the oxidising slag can be raked off with greater minuteness in the small size of furnace, but it is also due to a larger slag area in proportion to weight of bath. Phosphorus cannot be reduced in like degree, due to some extent to the greater care needed in adding ore, as the cutting action on the banks is slightly greater owing to the greater length of slag line per unit weight of metal.

It is the ability and art of the furnaceman in controlling his slags so as to obtain liquidity and correct thickness over the whole area of the bath throughout the charge, and more especially during the refining period, that determines whether sound metal is produced or not. In no other steel process

does the slag play such a vital part, or call for such wariness from the furnaceman. Five or ten minutes' neglect of the slag, and the metal often will be converted from sound to unsound material, as it becomes uncovered owing to the slag losing fusibility. The interplay between current and reagent, and whether to increase or reduce the amperage of the first, or which of several materials composing a slag to add in any contingency arising, become matters of intuition on the part of the operator, as well as calling on all his resources. What is required is the amount of confidence to be placed in the final product—the steel itself, and particulars of tests of electric steels made to Air Board specifications are given to show that the electric furnace is capable of making excellent nickel-chrome steels. It can be claimed from experience that nickel-chrome steels, during any given period (say, several months), and on an equal number of test-pieces and samples for inspection, will give a larger percentage of success than Siemens steels of the same composition. This is the test of time which any new process is called upon to meet. The torsion tests are particularly interesting. To obtain three revolutions of twist with a tensile strength of 67 tons, denotes density and sound material.

A practical application of this steel was made over two years ago when the demand for high-quality tungsten steel aero-engine exhaust valves was at its maximum; stamping dies, made from this nickel-chrome steel and used for embossing the valve, were watched. A pair of dies, used alternately, stamped 24,000 valves without requiring machining, and as the dies are still in use, it is estimated that 60,000 to 70,000 valves must have been stamped in them, with only a few machinings to resurface the dies.

With gas furnace heating of samples, the electric steel remains sound with 200 tons pressure, whereas the crucible steel crushes with loads of 190 and 199 tons respectively; the mean yield point of the crucible steel is 105 tons, of the electric, 112.5 tons.

The problem of die steels is very complex, as the purposes for which they are required are multitudinous, but the author shows that wear, shock, compression, and rigidity of shape, have all been satisfied by using electric steels of various qualities.

The cutting power of electric steels is next examined, but the factors and processes involved are so many that it is exceedingly difficult sometimes to form a judgment. As cutting involves another steel to be cut, and since this may be far from homogeneous, durability testing cannot be regarded in the same manner as tensile testing. It only requires one hard spot in the path of the tool under test to vitiate the result, by destroying a good tool nose, which would otherwise have had a long life. In a series of tests four tools (two crucible and two electric), 16 to 18 per cent. tungsten type, were made from four separate bars, and a research was carried out to find the relation of cutting speed to endurance. The author was not satisfied with the ordinary test that manufacturers usually adopted, of running at high speeds. He wanted to find out what happened at speeds lower than these, but yet well over ordinary shop practice, and particularly to determine the highest speed at which the curve would flatten out, *i.e.*, give a very long life. The electric steel tool gave the most satisfactory curve, and by dropping the speed from 55 to 45 ft. only, the life was increased from 8¼ minutes to 145¼ minutes.

Tests show that the electric steel survives the ordeal of drilling 200 holes of 2 in. in depth, leaving a tool still capable from all appearance of doing considerably more work, whereas the author has never yet obtained a crucible-steel drill which will do the same.

Dealing with the demand for an improved aero-engine exhaust-valve steel, the author submitted to Dr. Aitchison some samples which he anticipated might combine the advantages of the high tungsten quality with regard to strength at high temperatures, and also approach the low corrodibility of the high chromium steels. The following is an extract from his report:—

"The steel was tested in tension at temperatures of 700, 800, and 900 deg. C., and gave the following results: 19, 10.27, and 11.15 tons per sq. in. ultimate strength. The mechanical properties of the new steel in the cold are very similar to those of the high tungsten steels. As regards corrosion and scaling, the new steel is rather better than the tungsten steel, but inferior to the high chromium steel.

"This steel appears to show, in a comparatively marked manner, the increase of strength which occurs in both the tungsten and the chromium steels at temperatures higher than 800 (followed, of course, finally, by a fall in strength)." This steel was made in the electric furnace.

From costs got out some time ago, when conditions were much steadier than in these days, the author formed the opinion that a 15-20 ton electric furnace would produce as cheaply as a 50-ton acid Siemens furnace. The question of cost must never, however, be allowed to take first position in the steel-maker's mind; there is no compromising in steel-making—a good heat, even though it may have cost 5 or 10 per cent. or even more over the second best, will have proved the cheaper by the time the steel reaches bar form. Too many technologists are engaged in investigating complaints of bad steel; they would be better engaged in making good steel.

Nothing has been said about the adaptability of the electric furnace for making alloys which approach steel for strength, but have some other distinct property, such as electrical resistivity or non-corrodibility, &c., but these offer no difficulty which the furnacemen cannot solve, and are very often simpler to deal with than steel. It is certainly not advisable to apply crucible methods and receipts when making any mixture of the high-melting-point metals; no amount of killing agents—silicon, manganese, aluminium, magnesium, titanium—can take the place of a reducing slag under control. With a correct slag, killing agents are not necessary. Steel can be made sound in the electric furnace, heat after heat, no aluminium whatever being required, while an incorrect slag and its consequences cannot be remedied by adding aluminium to the ladles. This is a distinction peculiar to the electric furnace.

For making steel castings this process has been tried for some considerable time with results which have more than satisfied the foundrymen. The possibilities of the electric furnace are by no means fully explored, but it is clearly shown in the paper that it is a very flexible tool. The type of men available to obtain the best from it constitutes the real problem. The steels described were all made in Messrs. J. Beardshaw & Son, Ltd.'s, electric furnace.

THE NEW YORK CENTRAL WIRELESS STATION.

At first sight it would appear that little remained to be accomplished in wireless development of a revolutionary character. Yet once again a new departure, so far at least as aerial construction is concerned, is disclosed. As has already been announced in our columns, the Radio Corporation of America is about to commence the construction, on the north shore of Long Island, near New York, of a "super-powered" wireless station that will be capable of simultaneously sending to and receiving messages from five nations of other continents.

The steel aerial towers of the "New York Radio Central Station," as it is to be called, will cover a 6,400-acre tract of land, comprising an area of nearly 10 sq. miles lying east of Port Jefferson, with a long frontage on Long Island Sound. The preliminary engineering studies have been completed, and contracts for the construction materials are being let. According to the *T. & T. Age*, from which the following information concerning the station is abstracted, five complete transmitters, each one a duplex unit with a corresponding

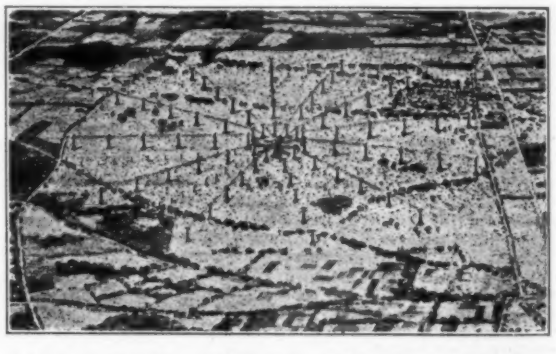


Fig. 1.—The New York Central Wireless Station.

receiver located near by, are to be installed. All five transmitters and the five receivers will operate simultaneously and continuously during day and night.

As will be seen from fig. 1, the aerial construction is wholly a new departure. From the central power house six spans of aerial wire will radiate in a star-pattern to a distance of over a mile from the centre. The antenna wires will be carried on self-supporting steel towers, each 400 ft. high, with the wires suspended at the top between 150-ft. cross arms. Each of the six antennæ will have 12 towers, forming, so to speak, the spokes of a wheel fashioned out of 72 towers. Five of the antennæ spokes will be for regular service, while the sixth is to be reserved for emergency operation.

The system and plant to be installed for each of the five units will be the same as that at present used in the Corporation's New Brunswick (N.J.) station, from which in experimental tests successful conversation has been carried on by means of the wireless telephone over distances of 2,500 miles. The generation of the required energy will be effected by high-frequency, continuous-wave Alexanderson alternators, which will permit high-speed signalling. Mr. Alexanderson is chief engineer of the Corporation, and his 200-kw. machine installed at the New Brunswick station "has proved itself

reliable." In the new station there will be two 200-kw. machines for each transmitting station, that is to say, ten in all, aggregating 2,000 kw., or 3,000 h.p.

Mr. E. J. Nally, president of the Corporation, emphasises another refinement that is to be incorporated in the new station. "We will utilise what is termed a multiple-tuned antenna, which," he explains, "materially reduces the wasteful electrical resistance of the long, low, flat-top aerials formerly used. A large saving in power is thus effected; in fact, we obtain with this form of antenna the same effect at a given distance with 200 kw. input, as would be obtained from the old type of antenna with 1,200 kw. input. The new type of antenna is the equivalent of six independent radiators, all operating in unison at the same wave length, and for the whole station with its five antennæ units, the power required will be less than 20 per cent. of that formerly necessary. We may, in many cases, utilise but one-half of a single spoke of the so-called antenna wheel system for communication service to a certain point. The station will thus ultimately permit simultaneous transmission to a maximum number of ten points, which would double the facilities originally planned."

"The receiving aerials are of a new type, too; they will operate with the Weagant system of 'static' elimination, which, by a combination of opposed electrical circuits, nullifies the effects of atmospheric electricity. We disregard precedent again in locating our receiving units only 18 miles from the multiplex transmitting equipment, instead of establishing a transmitter and receiver in one locality and restricting the service to one destination."

The arrangements for distant control of the new station follow the same policy of concentration. All messages will ultimately be dispatched and received, together with the Marconigrams at present being handled, from the Corporation's public telegraph office in Broad Street, New York City.

Many details of technical interest and engineering importance are embraced in the specifications for the new station, which have been prepared by the combined *personnel* of the Corporation and the American General Electric Co.

THE WORLD'S SUPPLY OF ENERGY.

In a paper recently presented to the Franklin Institute, U.S.A., on the occasion of his reception of the Franklin Medal in recognition of his contributions to the theory of physical science, Prof. S. A. Arrhenius, of the Nobel Institute, Stockholm, dealt with the problem of the world's supply of energy. What follows is an abstract of the paper as published in the *Journal* of the Franklin Institute:—

The demand for fossil coal has increased very rapidly, about doubling every ten years during the last century, and is now some 1,200 millions of metric tons per year. The quantity of fossil coal down to a depth of 1,800 metres would suffice for 6,000 years, at the present rate of consumption, if it were all recoverable, but this is not possible. It is, therefore, necessary to reduce the indicated time considerably, probably to 1,500 years.

Of the different countries the United States, in the matter of coal, has the best position, as it has in the matter of other natural resources. The coal treasures there will probably suffice for about two thousand years. The worst situation among the great coal-producing countries is that of England, where the coal will be exhausted within a little less than two hundred years. Germany will be able to meet its demands during a little more than a thousand years. This time is very short, and it is clear that we must soon ration our coal, and substitute as far as possible for fossil fuel other sources of energy.

The world's yearly production of mineral oils represents not quite 3 per cent. of the energy contained in the yearly production of coal. Petroleum ought, therefore, to be reserved for better purposes, *e.g.*, production of light and lubricants. Further, the recent failure of many oil fields indicates that we must economise this valuable material. If we consider the present fields of the United States, at the present rate of exploitation petroleum will be exhausted by about 1935. There are very rich new oil fields in the world which are still not used, or only in a small degree, *e.g.*, in Mexico, Mesopotamia, and Turkestan, but certainly they will not last as long as the coal fields, even if the production of this fuel is restricted to but 3 per cent. of the simultaneous production of the latter.

Still much less is the hope that sources of natural gas may deliver more than a small fraction of the fuel value of the oil fields. Even peat, although an important fuel, can by no means compete with coal; for instance, in the United States the available peat is less than one-half of 1 per cent. of the estimated coal. Probably the relative value of the European peat bogs is about the same as compared with the European coal fields. For heating purposes petroleum and peat cannot play an important rôle as compared with coal.

According to an estimate of Engler, the energy which might be economically taken from waterfalls amounts to about 60 per cent. of the energy of the present output of coal. But many waterfalls are located in inaccessible parts of the world, where no industry is likely to be developed for a long time, so it seems wise to reduce the figure of Engler about 50 per cent. If this is done, there is little hope that "white coal" will be able to replace black, except in a small degree. For heating purposes water power will probably not be used to a noteworthy degree, because used directly for the production of mechanical or electrical energy it is at least three times as valuable as the equivalent quantity of heat. Further, the well-situated waterfalls are already developed in greatest part, at least, in Europe. During the war, when there was a great scarcity of fuel, and even now, when fuel is extremely expensive, waterfalls were and rapidly are being put to use. Within a short time, therefore, this source of energy will be taken into the service of man, not sensibly diminishing the demand for coal.

Europe and Asia are the only parts of the world where water power is really scanty—in Asia the demand is still so small that even 0.5 h.p. per inhabitant is more than sufficient. Especially fortunate are those countries, such as the South American Republics, and Australia, where water power per unit of population is well beyond this figure, and may be developed at a moderate cost. The United States is among the great powers very well endowed in this regard, as in most other natural sources of wealth, such as metal, ores, and coal. In Europe, Iceland ranks first, because of its small population, and the old Saga Island may yet know a new and flourishing era. Then come the Scandinavian countries, the first being Norway, which has already greatly profited through its cheap power, and is destined to be one of the leading industrial countries of the future. Sweden and Finland possess enough power for their needs. Their waterfalls are not high, and in general are far from established lines of communication, especially from those of the ocean. Denmark has scarcely any water power, nor has Holland. Among the other countries of Europe the Balkan States have more power than their industrial needs require. Switzerland may also be regarded as having a nearly sufficient supply of water power, which is the more fortunate, as this highly industrial country does not own any coal deposits. The same is true of the new Austria, which has lost its old coal districts, but has retained by far the greater part of the waterfalls of the old Austria, so that it now probably ranks with Switzerland in this respect. Spain is also a relatively well situated State, but up to the present has not made much use of its resources. In general, the waterfalls in the Alps, Spain, Italy, and the Balkans are high and of great value. For the industries of France and Italy water power is of the greatest importance, although it must be regarded as insufficient for nations so highly developed. At the end of the list come the three great powers of Great Britain, Germany, and Russia, with only a fiftieth horse-power per inhabitant. Russia is an agricultural country, with a very small demand for power, and agriculture will probably remain its chief industry because of its small power resources, both in coal and water. England and Germany, now the most highly developed industrial countries in the world, will undoubtedly also, in the future, have agriculture for their chief industry. Probably a great part of these countries will again be covered with forests, as in the time of Tacitus.

It is possible to utilise the power of tidal waves, but doing so on a large scale would involve an initial investment not justified by prices likely ever to be obtained for power. The energy of the tidal wave is so widely distributed along the shores of the oceans that it is impossible to commercially collect a sensible part of it.

All available energy on the earth has its origin in solar radiation. Of this energy a small part, 0.12 per cent., is accumulated in vegetation, which, however, is great as compared with the energy of the coal burned in the industries. The energy collected by forests may be used for heating purposes, and exceeds every year that of the coals burnt by about 14 times. But the highly cultivated countries are so nearly deforested that their production of wood is not nearly sufficient as fuel for their industries. Further, the wood produced in civilised countries is needed for the production of paper, pulp, and lumber. During the war even the industrial needs of certain countries for combustibles were met by wood; the costs, however, were very high, due to expensive transport, and the transport of wood from the immense forests in the tropics to industrial countries seems impossible on economic grounds.

Two other sources of energy, greatly dispersed in form, are those of the winds and of sunshine. They are extremely great, and exceed the power of simultaneously burnt coal from 5,000 to 70,000 times, respectively. The objection to wind as a source of power is its variability, and the high installation costs per unit of power continuously deliverable. To store the energy of the wind by means of accumulators, charged from windmills, even in windy countries, *e.g.*, Denmark, is extremely uneconomical, as compared with coal or wood at their present price.

After improvements the solar engine seems likely to play an important rôle in the opening up for cultivation of great arid districts in tropical countries. Great deserts, such as the Sahara, the Arabian desert, the Syrian desert, and those in Mesopotamia, have in historical times been the seat of flourishing culture. The decay of these regions resulted from the destruction of their aqueducts and irrigation plants, which the present wandering population is unable to restore. With the aid of the solar machine it would be possible to re-establish

the old agriculture and horticulture of these districts, and industrial works founded on its use might also be looked forward to. It is not only in the deserts that the sun is shining nearly continuously during the greatest part of the year, but extensive provinces in Spain, Greece, and North America possess such a climate that they would profit by the introduction of the solar engine. It seems very probable that when fossil fuel has been consumed, civilisation and culture will return to its birthplace about the Mediterranean and in Mesopotamia in the old world, and to Central America and the land of the Incas in the new.

According to some calculations made by me an increase of the carbonic acid in the atmosphere will give the whole earth a more uniform and warmer climate. Therefore, we may suppose that the burning of coal will cause our climate to approach to that of the tertiary age. Furthermore, vegetation is highly stimulated through absorption of carbonic acid in the soil, augmented through an increase of the carbonic acid in the air. It is, therefore, probable, as I have tried to show in my book, "Worlds in the Making," that the total consumption of the available coal by the industries will, in a high degree, favour agriculture and the growing forests in the temperate regions now the chief seat of culture. These regions will then know not only harmful, but some useful consequences as the result of the present waste of our fuel resources.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

26,783. "Electric terminal and tester for use on motor cars, &c." A. N. Drummond. September 20th.
26,786. "Electric heating apparatus." E. J. V. Earle and J. J. J. M. Kluytmans. September 20th.
26,807. "Indicating and safety gap device for internal combustion engines employing electrical ignition." F. W. Conway. September 20th.
26,808. "Transformers, &c." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 20th.
26,830. "Cut-outs for electric circuits." M. Grob & Co. September 20th. (Switzerland, September 20th, 1919.)
26,826. "Thermo-electrically driven floating forts, ferries, &c." W. P. Durtnall. September 20th.
26,846. "Signalling device for tramcars, &c." F. Aspden. September 21st.
26,870. "Electromagnetics." E. E. Dutt. September 21st.
26,871. "Generation of electricity from latent energy." E. E. Dutt. September 21st.
26,873. "Electric heating and ventilating apparatus." T. Gunn, Ltd., and H. J. Tibbles. September 21st.
26,875. "Electromagnetic wave systems, &c." B. Binyon and Radio Communication Co. and J. Scott-Taggart. September 21st.
26,884. "Sparking plugs." H. Molla. September 21st. (France, September 24th, 1919.)
26,887. "Electrical resistances." J. L. Lafeuille. September 21st. (France, September 22nd, 1919.)
26,888. "Oil-immersed transformers." W. J. Boddy and British Thomson-Houston Co. (General Electric Co.). September 21st.
26,889. "Means for controlling electric switches." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 21st.
26,894. "Electric switches." O. Lucas and W. C. Turner. September 21st.
26,899. "Electromagnetic horns, &c." E. Magerle. September 21st. (Austria, April 10th.)
26,901. "High-frequency signalling." Western Electric Co. September 21st. (U.S., September 29th, 1919.)
26,904. "Switch devices." Krupp Akt.-Ges., F. & T. W. Rogers (Krupp Akt.-Ges.). September 21st.
26,913. "Electric lamp holders." J. W. Goddard, A. H. Hunt. September 21st.
26,915. "Device for heating by electricity." A. Negromanti. September 21st. (Italy, September 19th, 1919.)
26,923. "Receivers for wireless signalling." J. L. Hogan and O. Imray (International Radio Telegraph Co. and Hogan), and International Radio Telegraph Co. September 21st.
26,935. "Electrical means for indicating at a distance the motion of apparatus." Eversbed & Vignoles and J. C. Needham. September 21st.
26,940. "Hydro-electric plant." D. D. Drury. September 21st.
26,944. "Electric resistances." Crompton & Co. and W. F. Jones. September 22nd.
26,945. "Electric resistances." Crompton & Co. and W. F. Jones. September 22nd.
26,946. "Electric rheostats or resistances." Crompton & Co. and W. F. Jones. September 22nd.
26,950. "Telegraph keyboard perforator." A. C. Booth and A. S. Willmot. September 22nd.
26,959. "Electric lamp sockets." W. Bird, A. V. Watson, and G. J. Wells. September 22nd.
26,978. "Draw bar connections for trams, &c." W. Camp. September 22nd.
26,983. "Miners' electric lamps." E. E. Gardner. September 22nd.
26,990. "Electric cut-out." W. H. Illingworth. September 22nd.
26,994. "Removing gas residues and purifying inert gases in electric vacuum tubes, &c." G. Holst and Naamlooze Vennootschap Philips' Gloeilampenfabrieken, and E. Oosterhuis. September 22nd. (Holland, September 23rd, 1919.)
26,999. "Regulating systems for alternating current circuits." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 22nd.
27,004. "Process for regulating voltage in metal vapour rectifier installations." Akt.-Ges. Brown, Boveri et Cie. September 22nd. (Switzerland, September 22nd, 1919.)
27,006. "Laying and construction of underground conduits for cables, &c." O. C. Summers. September 22nd.
27,009. "Commutators for electrical machines formed from a ring of wedge-shaped elements." R. A. L. Volet. September 22nd. (Belgium, May 21st.)
27,011. "Electrical speed regulator systems." Metropolitan-Vickers Electrical Co. and L. Miller. September 22nd.
27,023. "Electric switch with automatic contacts." D. M. G. Robniot de la Pichardais. September 22nd. (France, September 23rd, 1919.)
27,034. "Electric arc lamps." A. H. T. Boswell. September 22nd.
27,041. "Means for establishing intercommunication between front and rear engines in electric trains." H. Parodi. September 22nd.
27,042. "Bodies for thermo-electric self-propelled vehicles." W. P. Durtnall. September 22nd.
27,050. "Loading-coils for super-imposed telephones, &c." H. W. Sullivan. September 23rd.
27,074. "Electrical device for control of belt-driven machinery." E. J. Henson. September 23rd.
27,075. "Rotary fuse holder." J. A. Smith. September 23rd.
27,077. "Electric switches." C. G. Bennett and H. Garde. September 23rd.
27,079. "Electric vulcaniser." F. Bolus. September 23rd.
27,084. "Electric motor cycle." E. G. Blair and N. V. Snelling. September 23rd.
27,092. "Electric power plant for steam railways." R. J. Insell. September 23rd.
27,104. "Motor control systems for electric lifts, &c." Otis Elevator Co. and Waygood-Otis, Ltd. (Otis Elevator Co.). September 23rd.
27,107. "Carbon commutator brushes, &c." F. A. Cramer and H. Marryat. September 23rd.
27,112. "Systems of electrical distribution." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 23rd.
27,177. "Electric accumulators." E. A. Sibthorpe. September 24th.
27,181. "Barrel apparatus for electro-deposition of metals." W. Turton. September 24th.
27,183. "Manufacture of filaments or threads of silica, alumina, &c." M. de Roiboul. September 24th. (France, June 16th.)
27,188. "Electromagnetic wave systems, &c." B. Binyon, Radio Communication Co., and J. Scott-Taggart. September 24th.
27,189. "Relay devices, &c." Radio Communication Co. and F. Scott-Taggart. September 24th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

5,613. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co.). April 17th, 1916. (150,357.)
10,850. "Electron discharge apparatus. The British Thomson-Houston Co. (General Electric Co.). August 1st, 1916. (150,359.)

1918.

21,811. "Method for transforming the kinetic energy in gases into electrical energy and manner for utilising the latter for carrying out gas reaction." C. Petersen. December 30th, 1918. (Convention date not granted.) (122,173.)

1919.

8,257. "Electric arc welding." F. J. Heyes. April 2nd, 1919. (Cognate application, 19,366/19.) (150,372.)
10,780. "Sparking plugs for internal combustion engines." C. E. Tinson and G. N. Travers. April 30th, 1919. (150,376.)
10,910. "Microphones or electric transmitters for submarine signalling and the reception of subaqueous vibrations." J. Gardner. May 2nd, 1919. (150,379.)
13,296. "Electrically heated coverings." A. Negromanti. May 27th, 1919. (150,394.)
13,435. "Sparking plugs." T. Morgan. May 28th, 1919. (150,398.)
13,536. "Switch contacts for multiple electric switches." R. L. Murray and Telephone Manufacturing Co. May 28th, 1919. (150,404.)
13,625. "Coil winding machines." Igranic Electric Co. and S. R. Wright. May 29th, 1919. (150,413.)
13,626. "Coil winding machines." Igranic Electric Co. and S. R. Wright. May 29th, 1919. (150,414.)
13,634. "Amplification of electric currents." British Thomson-Houston Co. (General Electric Co.). May 29th, 1919. (150,415.)
13,884. "Electric power generating sets." H. R. Ricardo. June 2nd, 1919. (150,425.)
14,367. "Sparking plug for internal combustion engines." F. A. Jennings. June 6th, 1919. (150,444.)
15,880. "Electric incandescent lamps." British Thomson-Houston Co. (General Electric Co.). June 24th, 1919. (150,468.)
16,629. "Incandescent electric lamps." G. Calvert. July 2nd, 1919. (150,484.)
16,809. "Electric fuses." T. Keating. July 4th, 1919. (150,489.)
19,185. "Sparking plugs for internal combustion engines." H. G. Longford, W. W. Longford, and W. A. Clark. August 2nd, 1919. (150,513.)
19,260. "Electric heating devices." British Thomson-Houston Co. (General Electric Co.). August 5th, 1919. (150,514.)
19,613. "Tuned ionic oscillator." R. Whiddington. August 9th, 1919. (150,516.)
20,237. "Electric switches." C. F. Newey. August 18th, 1919. (150,523.)
20,482. "Sparking plugs." J. S. Coyle. August 20th, 1919. (150,524.)
21,583. "Electric furnaces." D. de Luca. September 2nd, 1919. (150,532.)
22,247. "Electromagnetic braking apparatus for electrically propelled railway and tramway vehicles." G. L. Meyfarth. September 19th, 1918. (132,788.)
25,953. "Alternating current rectifiers." H. Wade (H. S. Mills). October 22nd, 1919. (150,559.)
26,626. "Electric signs and the like." J. Smeekens. October 18th, 1916. (134,540.)
29,504. "Recovery of zinc by electrolysis." Electrolytic Zinc Co. December 3rd, 1918. (136,151.)
29,531. "Electric switching means for preventing unauthorised starting of motor vehicles." P. E. Monkhouse and G. Roberts. November 26th, 1919. (150,573.)
30,539. "Rotors of squirrel-cage induction motors." W. F. Higgs. December 6th, 1919. (150,579.)
31,626. "Means of casting leaden articles specially applicable to the casting of bridge-pieces on the lugs of accumulator plates." A. Collis and H. Dulton. December 17th, 1919. (150,586.)

1920.

363. "Electrolytic cells." W. J. Mellersh-Jackson (Allen Electrolytic Cell Corporation). January 5th, 1920. (150,595.)
654. "Zinc battery elements." S. O. Cowper-Coles. January 8th, 1920. (150,597.)
2,726. "Means for securing the field magnets of dynamo-electric machines." C. H. Vidal and A. Kettlewell. January 28th, 1920. (150,615.)
3,987. "Electrical resistance apparatus." P. H. Dawe. February 9th, 1920. (Addition to 107,822.) (150,622.)
5,467. "Electric switches." S. Kobzy. February 23rd, 1920. (150,627.)
5,671. "Thermo-electric cells for electrical measuring apparatus." Westinghouse Lamp Co. February 27th, 1919. (139,486.)
8,491. "Electro-medical treatment of the human body." J. Myers. March 22nd, 1920. (150,643.)
8,882. "Electric switches." A. C. Smith. March 26th, 1920. (150,646.)
12,969. "Thermo-electric apparatus." W. H. Wilson. February 18th, 1919. (Cognate application 12,970/20. Divided applications on 144,757 and 18,612/19.) (150,656.)